HEATHKIT® MANUAL

HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R / C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and Home Clocks	(616) 982-3315
Television	(616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products	(616) 982-3496
Computer Hardware	(616) 982-3309
Computer Software	(616) 982-3860
Heath Craft Wood Works	(616) 982-3423

YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

SERIAL # 19-45462
for the
JUN 81

FUNCTION GENERATOR

Model IG-1271

595-1655-13

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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The IG-1271 Function Generator is a quality test instrument that will produce sine, square, and triangle waveforms over a frequency range of 0.1 Hz to 1 MHz. This wide range of frequencies is divided into six smaller ranges, and each range is variably controlled over a 100 to 1 frequency ratio.

The output supplies a 10-volt peak-to-peak signal into a 50-ohm load and features a calibrated attenuator that is adjustable in 10 dB steps, from 0 to 50 dB. Also included is a continually variable attenuator that provides up to 20 dB additional attenuation.

Most of the components are mounted on one circuit board which makes this unit easy to assemble. The compact size and light weight allows the Generator to be easily moved and allows it to be set almost anywhere.

Refer to the "Kit Builders Guide" for information on tools, wiring, soldering, and parts identification.

PARTS LIST

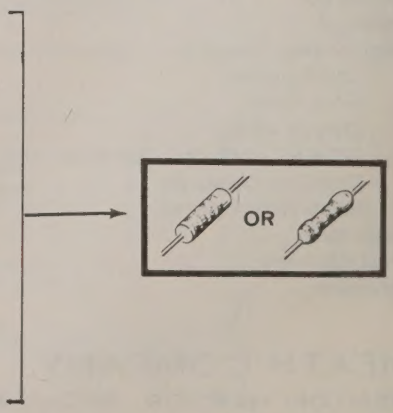
Check each part against the following list. Make a check (✓) in the space provided as you identify each part. Any part that is packed in an individual envelope with a part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not throw away any packing material until all parts are accounted for.

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual. For pricing information, refer to the separate "Heath Parts Price List."

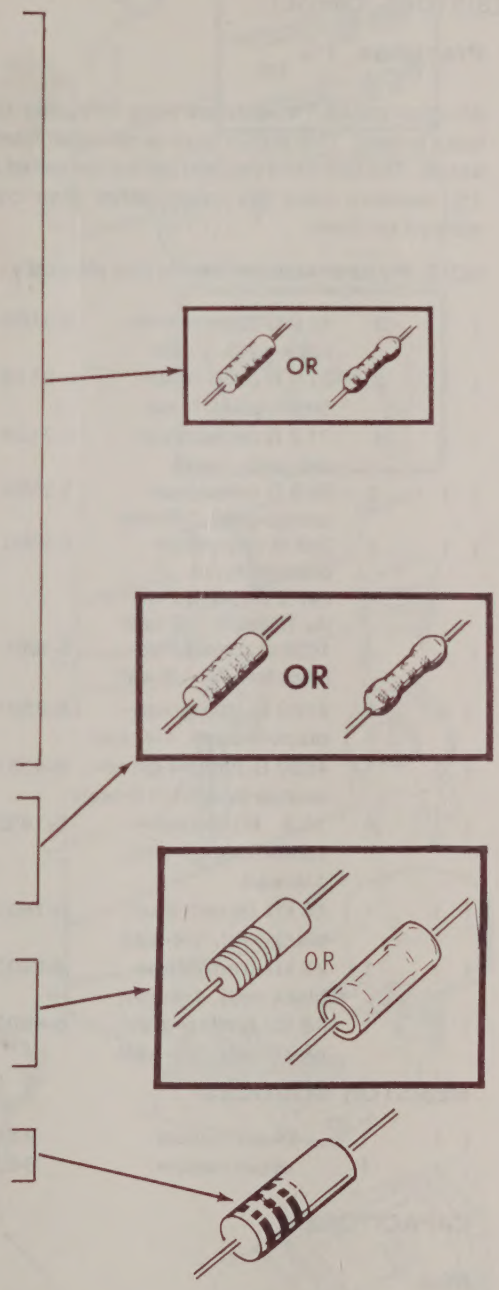
Each circuit part in this kit has its own component number (R2, C4, etc.). Use these numbers when you want to positively identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

- In the Parts List,
- At the beginning of each step where a component is installed,
- In some illustrations,
- In the Schematic,
- In the sections at the rear of the Manual.

QTY.		DESCRIPTION	PART No.	CIRCUIT Component No.
RESISTORS				
1/4-Watt				
( )	2	2.2 Ω, 5% (red-red-gold-gold)	6-229-12	R1, R3
( )	2	47 Ω, 5% (yellow-violet-black-gold)	6-470-12	R36, R37
( )	2	150 Ω, 5% (brown-green-brown-gold)	6-151-12	R31, R61
( )	1	220 Ω, 5% (red-red brown-gold)	6-221-12	R8
( )	2	330 Ω, 5% (orange-orange-brown-gold)	6-331-12	R19, R35
( )	1	470 Ω, 5% (yellow-violet-brown-gold)	6-471-12	R20
( )	1	560 Ω, 5% (green-blue brown-gold)	6-561-12	R21



QTY.		DESCRIPTION	PART No.	CIRCUIT Component No.
RESISTORS (Cont'd.)				
( )	1	620 Ω, 5% (blue-red-brown-gold)	6-621-12	R63
( )	1	680 Ω, 5% (blue-gray-brown-gold)	6-681-12	R38
( )	1	820 Ω, 5% (gray-red-brown-gold)	6-821-12	R41
( )	2	1000 Ω, 5% (brown-black-red-gold)	6-102-12	R22, R34
( )	2	2200 Ω, 5% (red-red-red-gold)	6-222-12	R12, R62
( )	1	2400 Ω, 5% (red-yellow-red-gold)	6-242-12	R9
( )	1	3600 Ω, 5% (orange-blue-red-gold)	6-362-12	R39
( )	2	4700 Ω, 5% (yellow-violet-red-gold)	6-472-12	R11, R43
( )	1	6800 Ω, 5% (blue-gray-red-gold)	6-682-12	R65
( )	2	8200 Ω, 5% (gray-red-red-gold)	6-822-12	R25, R28
( )	1	18 kΩ, 5% (brown-gray-orange-gold)	6-183-12	R42
( )	1	22 kΩ, 5% (red-red-orange-gold)	6-223-12	R64
( )	1	47 kΩ, 5% (yellow-violet-orange-gold)	6-473-12	R5
1/2-Watt				
( )	2	15 Ω, 5% (brown-green-black-gold)	6-150	R45, R46
( )	1	510 Ω, 5% (green-brown-brown-gold)	6-511	R15
1-Watt				
( )	1	330 Ω, 5% (orange-orange-brown-gold)	1-60-1	R18
( )	1	1500 Ω, 10% (brown-green-red-silver)	1-22-1	R44
2-Watt				
( )	1	47 Ω (yellow-violet-black)	1-41-2	R47



QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.

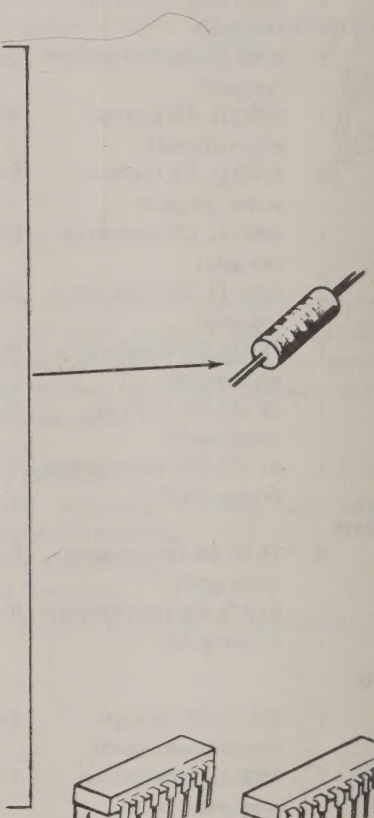
RESISTORS (Cont'd.)

Precision, 1%

All color coded 1% resistors have five color bands (last band brown). This brown band is set apart from the other bands. The last band (brown) will not be called out. Some 1% resistors have the value rather than color bands marked on them.

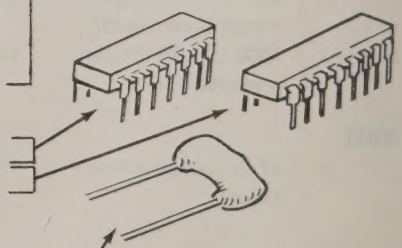
NOTE: Precision resistors vary in size physically.

( )	2	51.0 Ω (green-brown-black-gold), 1-watt	6-5109-1	R54, R56
( )	2	61.1 Ω (blue-brown-brown-gold), 1-watt	6-6119-1	R51, R53
( )	1	71.2 Ω (violet-brown-red-gold), 1-watt	6-7129-1	R58
( )	2	96.3 Ω (white-blue-orange-gold), 1/2-watt	6-9639	R57, R59
( )	1	248 Ω (red-yellow-gray-black), or, 247.5 Ω (printed on the resistor), 1/2-watt	6-2480	R52
( )	4	1000 Ω (brown-black-black-brown), 1/4-watt	6-1001-12	R13, R16, R24, R27
( )	1	2500 Ω (red-green-black-brown), 1/4-watt	6-2501-12	R55
( )	1	4530 Ω (yellow-green-orange-brown), 1/4-watt	6-4531-12	R29
( )	4	14.3 kΩ (brown-yellow-orange-red), 1/4-watt	6-1432-12	R14, R17, R66, R67
( )	1	16 kΩ (brown-blue-black-red), 1/4-watt	6-1602-12	R103
( )	1	24 kΩ (red-yellow-black-red), 1/4-watt	6-2402-12	R102
( )	1	48 kΩ (yellow-gray-black-red), 1/4-watt	6-4802-12	R101



RESISTOR MODULES

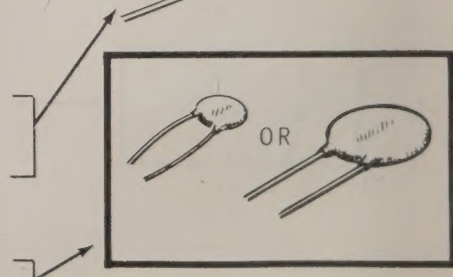
( )	1	14-pin module	9-61	RP1
( )	1	18-pin module	9-62	RP2



CAPACITORS

Mica

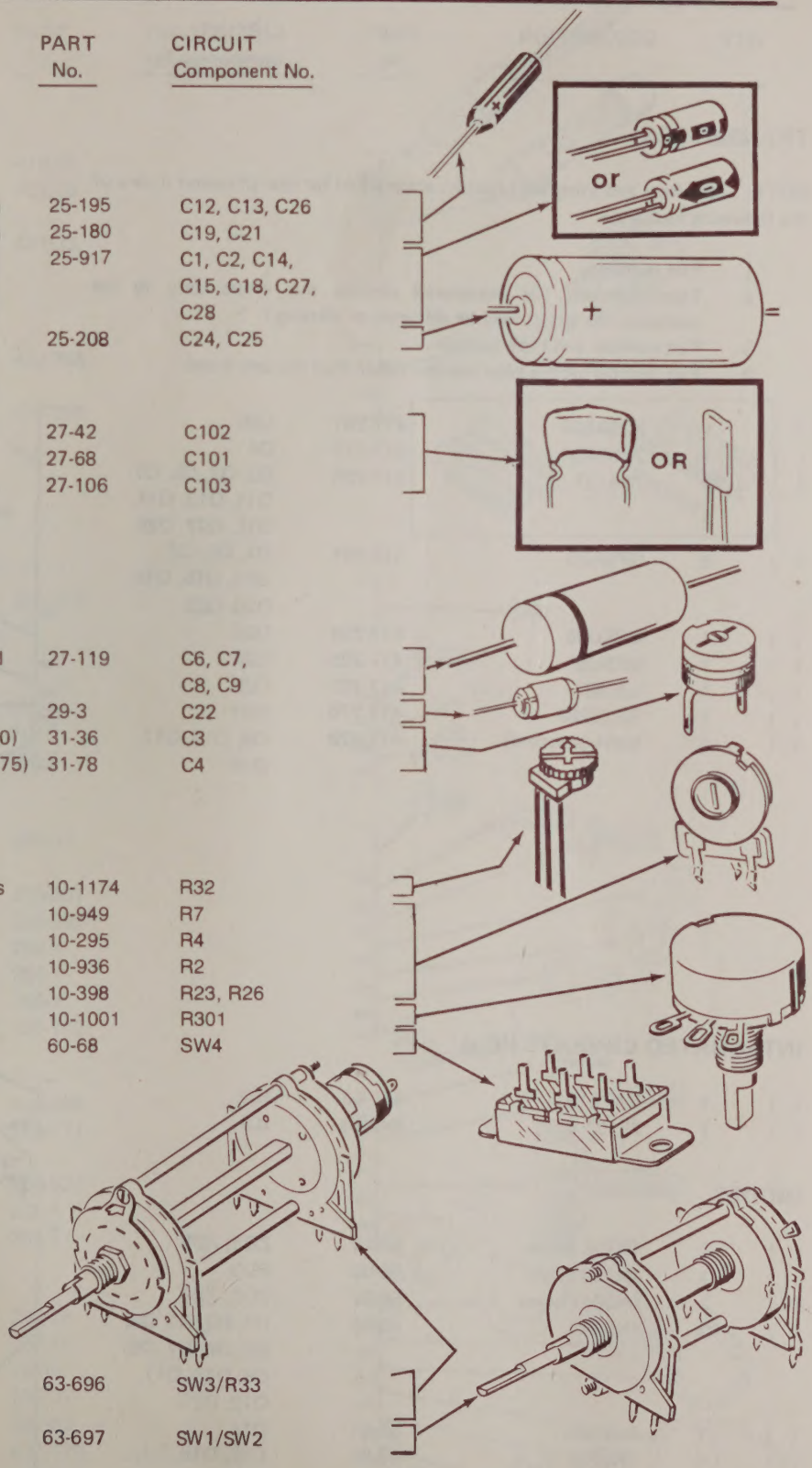
( )	2	42 pF	20-174	C16, C17
( )	1	56 pF	20-78	C20
( )	1	430 pF	20-133	C5



Disc

( )	1	15 pF	21-111	C11
( )	1	.01 μF 1.6 kV	21-42	C23

QTY.		DESCRIPTION	PART No.	CIRCUIT Component No.
Capacitors (cont'd.)				
Electrolytic				
( )	3	2.2 μF, 15V tantalum	25-195	C12, C13, C26
( )	2	2.2 μF, 50V tantalum	25-180	C19, C21
( )	7	10 μF	25-917	C1, C2, C14, C15, C18, C27, C28
( )	2	1500 μF	25-208	C24, C25
Mylar*				
( )	1	6800 pF (.0068)	27-42	C102
( )	1	3300 pF (.0033)	27-68	C101
( )	1	.01 μF	27-106	C103
Other				
( )	1set	Mylar* (four matched capacitors)	27-119	C6, C7, C8, C9
( )	1	2700 pF polystyrene	29-3	C22
( )	1	Ceramic trimmer (8-50)	31-36	C3
( )	1	Ceramic trimmer (10-75)	31-78	C4
CONTROLS-SWITCHES				
( )	1	500 Ω control w/leads	10-1174	R32
( )	1	300 Ω control	10-949	R7
( )	1	750 Ω control	10-295	R4
( )	1	1000 Ω control	10-936	R2
( )	2	2000 Ω (2 k) control	10-398	R23, R26
( )	1	1000 Ω (1 k) control	10-1001	R301
( )	1	Slide switch	60-68	SW4
( )	1	Rotary switch with control	63-696	SW3/R33
( )	1	Rotary switch	63-697	SW1/SW2



*DuPont registered trademark

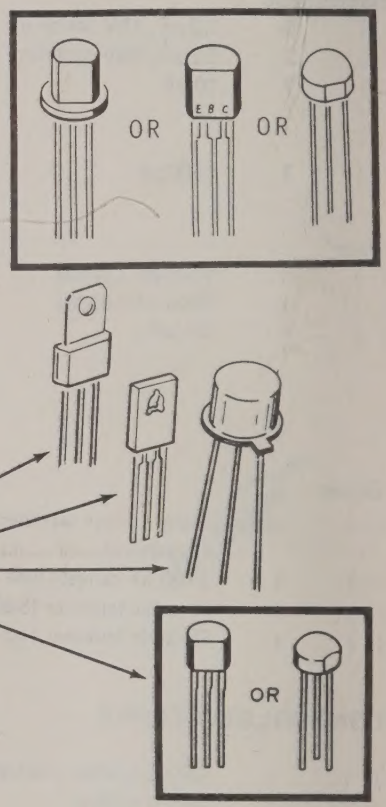
QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.

TRANSISTORS

NOTE: Transistors and integrated circuits are marked for identification in one of the following four ways.

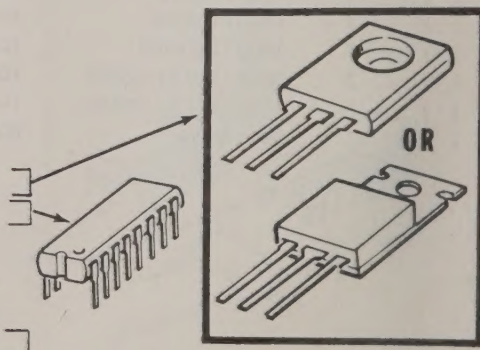
1. Part number.
2. Type number. (On integrated circuits this refers only to the numbers; the letters may be different or missing.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

( )	1	X29A829	417-201	Q26
( )	1	2N5249A	417-213	Q4
( )	10	2N4121	417-235	Q2, Q3, Q5, Q7, Q11, Q12, Q14, Q16, Q27, Q28
( )	8	MPSA20	417-801	Q1, Q6, Q8, Q13, Q15, Q19, Q20, Q23
( )	1	MPSU05	417-224	Q22
( )	1	MPSU55	417-225	Q24
( )	1	SJE607	417-263	Q25
( )	1	SGC5283	417-270	Q21
( )	4	E304 (selected)	417-828	Q9, Q10, Q17, Q18



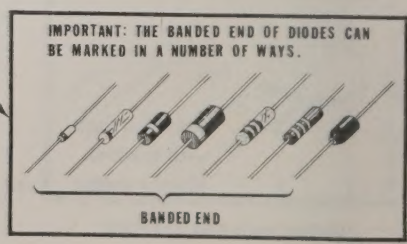
INTEGRATED CIRCUITS (IC's)

( )	1	UA7815	442-63	IC2
( )	1	75107	442-73	IC1

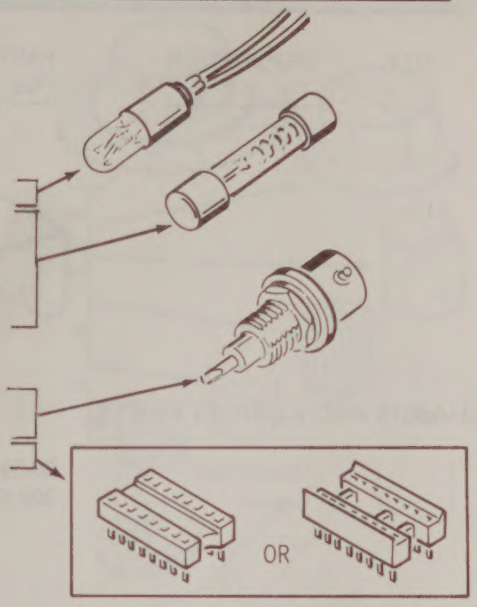


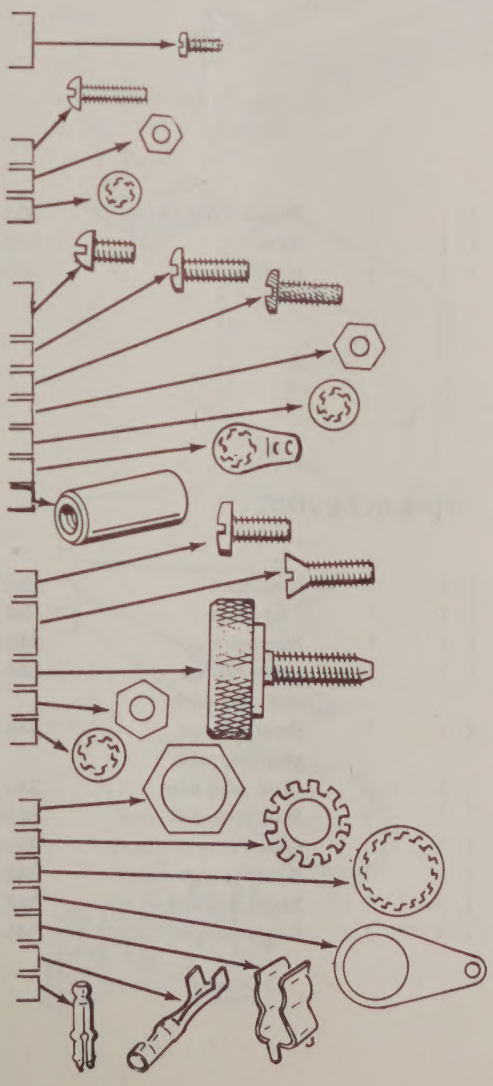
DIODES

( )	2	1N751 zener	56-16	ZD1, ZD5
( )	1	1N750 zener	56-59	ZD3
( )	2	1N3017 zener	56-97	ZD2, ZD4
( )	13	1N4149	56-56	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13
( )	1	Stabistor	56-61	D14
( )	4	1N4002	57-65	D15, D16, D17, D18

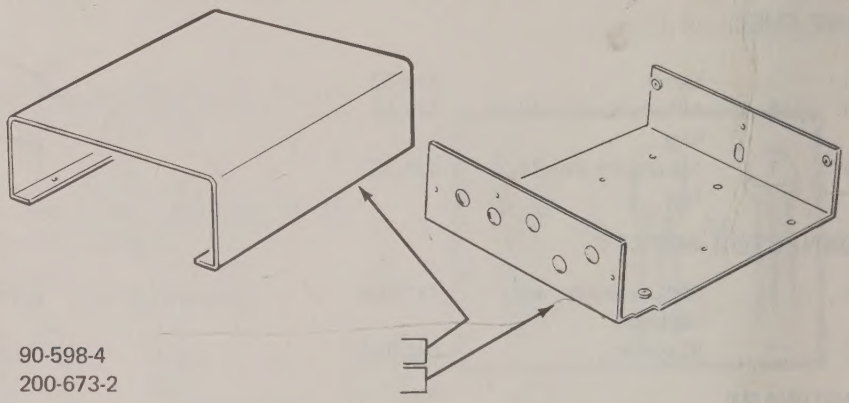


QTY.		DESCRIPTION	PART No.	CIRCUIT Component No.
LAMP-FUSE				
( )	1	Lamp	412-72	
( )	1	1/8-ampere slow-blow fuse	421-26	
( )	1	1/4-ampere slow-blow fuse	421-33	
CONNECTOR-SOCKET				
( )	1	BNC connector and hardware	432-758	
( )	1	IC socket	434-298	
HARDWARE				
NOTE: All hardware drawings are actual size.				
#2 Hardware				
( )	2	2-56 x 3/16" self-tapping screw	250-212	
#4 Hardware				
( )	1	4-40 x 3/8" screw	250-4	
( )	1	4-40 nut	252-2	
( )	1	#4 lockwasher	254-9	
#6 Hardware				
( )	1	6-32 x 1/4" round head screw	250-31	
( )	4	6-32 x 5/16" screw	250-587	
( )	9	6-32 x 3/8" black screw	250-381	
( )	2	6-32 nut	252-3	
( )	5	#6 lockwasher	254-1	
( )	1	#6 solder lug	259-1	
( )	4	6-32 x 5/8" spacer	255-142	
#8 Hardware				
( )	1	8-32 x 5/16" screw	250-362	
( )	1	8-32 x 1/2" flat head screw	250-571	
( )	2	Thumbscrew	250-527	
( )	2	8-32 nut	252-4	
( )	2	#8 lockwasher	254-2	
Other Hardware				
( )	5	Control nut	252-76	
( )	2	1/4" external lockwasher	254-12	
( )	3	Control lockwasher	254-5	
( )	1	Control solder lug	259-27	
( )	2	Fuse clip	260-65	
( )	5	Female connector	432-120	
( )	5	Male connector	432-121	



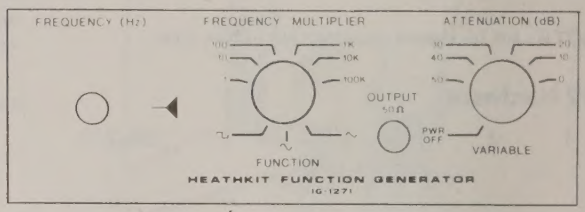


QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.

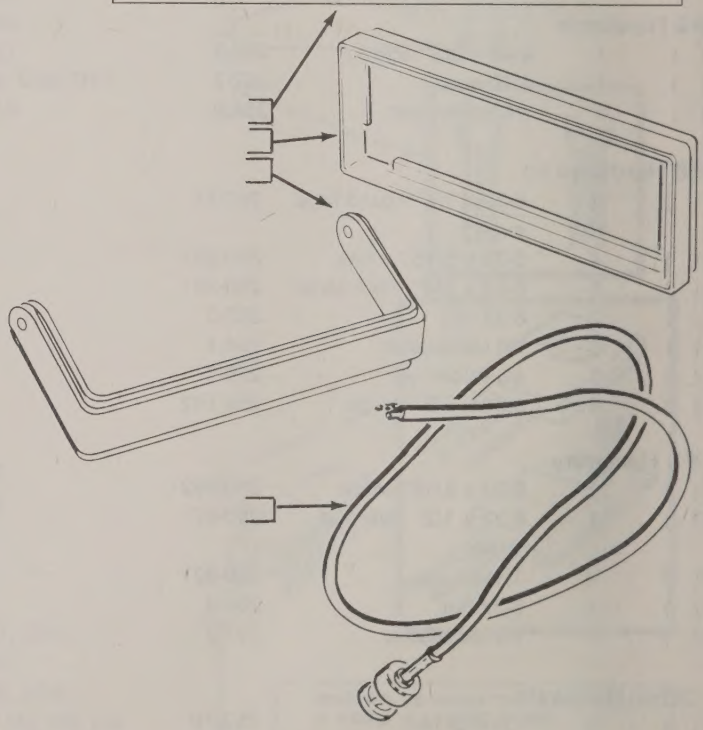


CHASSIS AND CABINET PARTS

( )	1	Cabinet top	90-598-4
( )	1	Chassis	200-673-2



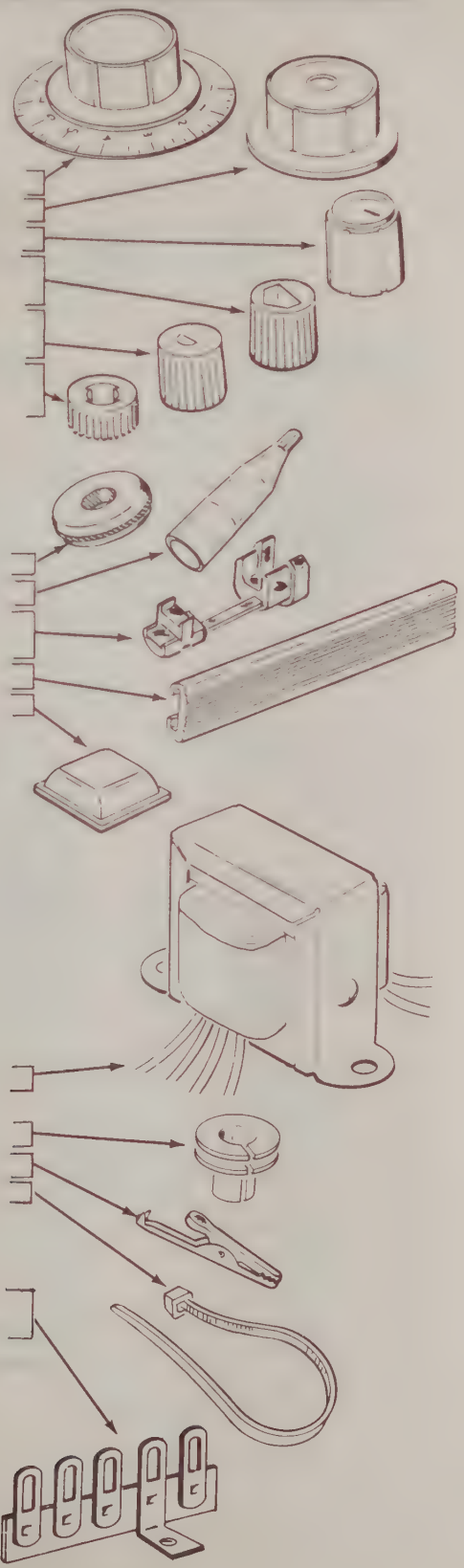
( )	1	Plastic front panel	203-1613
( )	1	Bezel	210-89
( )	1	Handle	211-63



WIRE-SLEEVING

( )	1	Line cord	89-22
( )	1	Test cable	134-237
( )	1	Bare wire	340-8
( )	1	Large orange stranded wire	344-30
( )	1	Small orange stranded wire	344-93
( )	1	Blue solid wire	344-56
( )	1	Blue stranded wire	344-96
( )	1	Green stranded wire	344-95
( )	1	White-orange wire	344-116
( )	1	Small sleeving	346-35
( )	1	Large sleeving	346-46

	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.
KNOBS-BUSHINGS				
( )	1	Calibrated knob	462-919	
( )	2	Large knob	462-361	
( )	2	Small knob	462-363	
( )	1	Large bushing with large hole	455-50	
( )	2	Large bushing with small hole	455-71	
( )	2	Small bushing with large hole	455-613	
INSULATORS-FEET				
( )	1	Rubber grommet	73-1	
( )	2	Test clip insulator	73-34	
( )	1	Line cord strain relief	75-182	
( )	1	Rubber channel strap	211-59	
( )	4	Plastic foot	261-34	
MISCELLANEOUS				
( )	1	Power transformer	54-271	
( )	1	Circuit board	85-2149-3	
( )	1	Heat sink	215-31	
( )	2	Alligator clip	260-16	
( )	1	Cable tie	354-7	
( )	1	Caution label	390-926	
( )	1	Blue and white label	391-34	
( )	1	5-lug terminal strip	431-77	
( )	1	Parts Order Form	597-260	
( )	1	Kit Builders Guide	597-308	
( )	1	Assembly Manual (See Page 1 for part number.)		
		Solder		

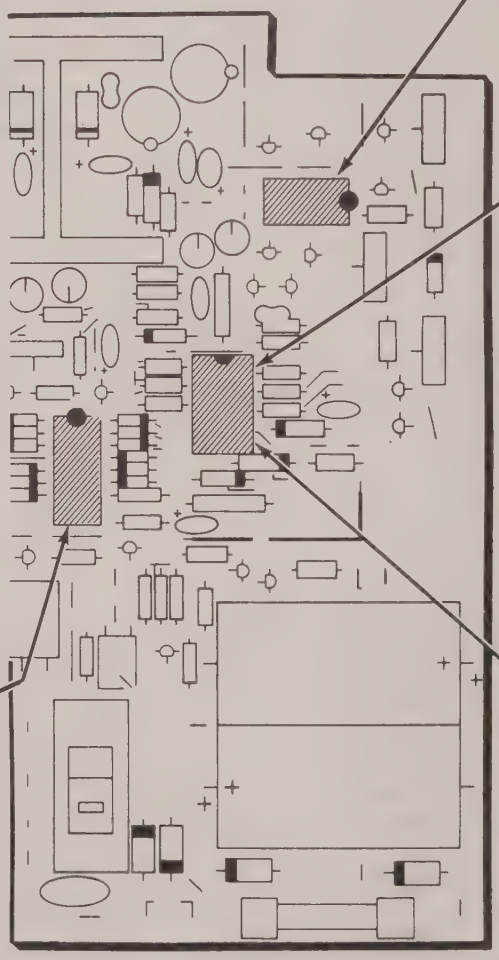


STEP-BY-STEP ASSEMBLY

The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION DRAWING

PART NUMBER



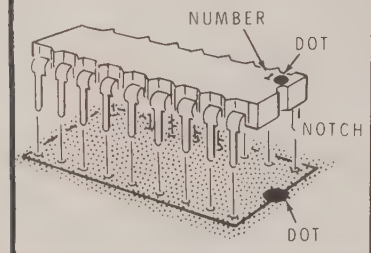
PICTORIAL 1-1

START

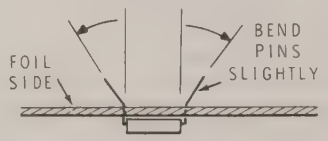
(√) Lay the circuit board in front of you, as shown, with the printed side up. The under side is called the foil side.

In the following Pictorials, only part of the circuit board will be shown. Refer to the shaded area of the identification drawing at the top of the Page for the area of the circuit board that you are working on.

NOTE: The resistor modules that you will install in the next two steps will have an identification mark on one end. This identification mark may be the number 1, a dot, or a notch. Other numbers may also appear on the module. Position the marked end of the module over the dot on the circuit board.



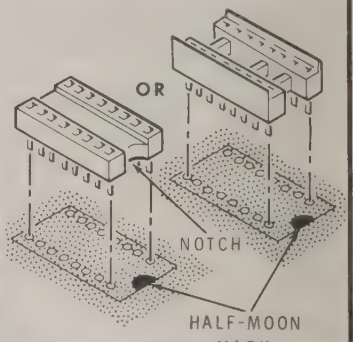
(√) RP2: 18-pin resistor module (#9-62). Bend each pin out slightly on the foil side of the circuit board to hold the module in place. DO NOT bend the pins over flat against the circuit board and do not solder the pins of this module until you are told to do so. This is to prevent solder from filling nearby holes.



CONTINUE

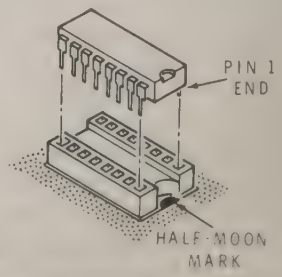
(√) RP1: 14-pin resistor module (#9-61). Make sure each pin goes through the circuit board. Then solder each pin to the foil.

(√) Integrated circuit socket. Insert the socket pins into the holes. The half-moon mark on the circuit board should still be visible after it is installed. Solder the pins to the foil.



(√) Refer to Detail 1-1A on the fold-out from Page 15 and identify the pin one end of the 75107 integrated circuit (#442-73). Also read the "Note" on the fold-out from Page 15.

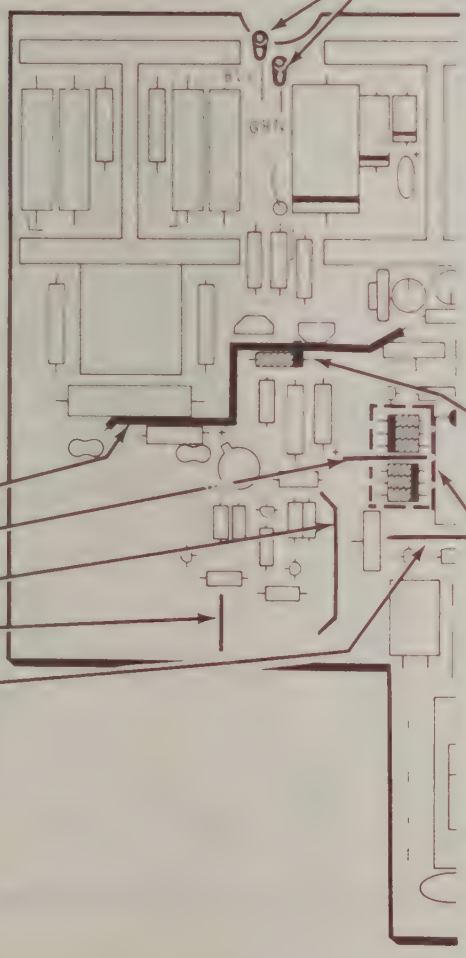
(√) Position the pin 1 end of this integrated circuit toward the half-moon mark on the circuit board. Then carefully install the integrated circuit. Make sure all the pins are in their respective holes.



IDENTIFICATION DRAWING

The steps performed in this Pictorial are in this area of the circuit board.

PART NUMBER



START

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. We suggest that you wear safety glasses and hold the lead while you cut it off so that it cannot fly up.

NOTE: When wire is called for, as in the next step, cut the wire to the length indicated. Then remove 1/4" of insulation from each end of the wire. If bare wire is called for, cut a piece of bare wire to the length indicated.

( ) 3-3/4" blue solid wire.

( ) 1-1/4" bare wire.

( ) 1-3/4" bare wire.

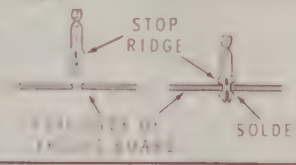
( ) 1" bare wire.

( ) 1-1/4" bare wire.

( ) Solder the wires to the foil and cut off the excess wire lengths.

CONTINUE

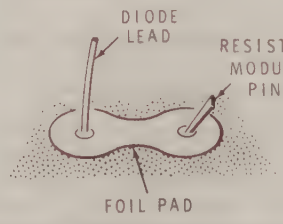
( ) Install two male connector pins. Insert the pins into the circuit board until the ridge seats against the board. Then solder each pin to the foil.



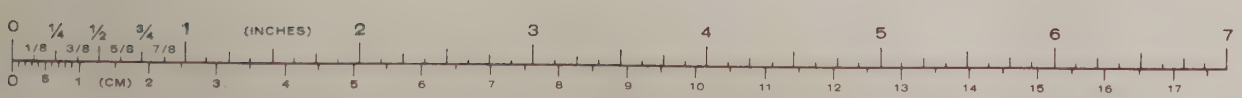
NOTE: When you install diodes, be sure to position the banded end of the diode as shown on the circuit board. A DIODE WILL NOT WORK IF IT IS INSTALLED BACKWARD.

( ) D14: Stabistor diode (#56-61). Solder the leads to the foil and cut off the excess lead lengths.

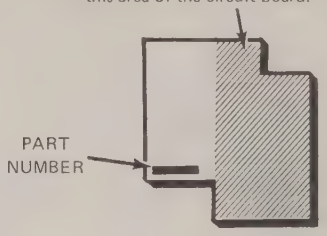
( ) 1N4149 diodes (#56-56) at D9, D11, D13, D7, D5, and D3. Note that three of these diodes face one direction and the other three face the opposite direction. Solder the diode leads to the foil and cut off the excess lead lengths. NOTE: If you get solder on a resistor module pin that is on the same foil pad as a diode lead, it is alright. Be careful that you do not bridge solder across two foils.



PICTORIAL 1-2



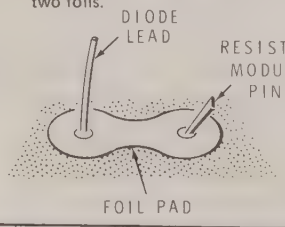
The steps performed in this Pictorial are in this area of the circuit board.



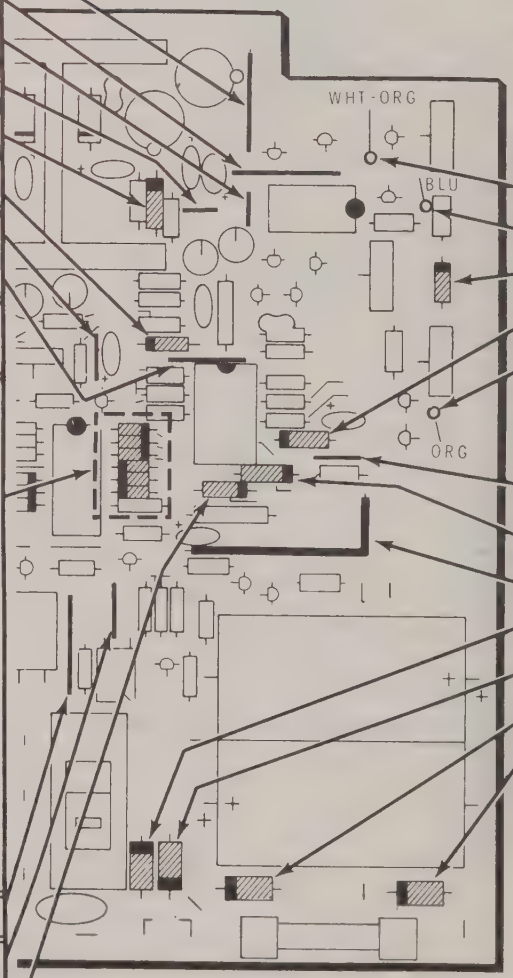
IDENTIFICATION DRAWING

START

- ( ) 1-1/2" bare wire.
- ( ) 1-1/2" bare wire.
- ( ) 3/4" bare wire.
- ( ) 3/4" bare wire.
- ( ) ZD4: 1N3017 zener diode (#56-97).
- ( ) ZD1: 1N751 zener diode (#56-16).
- ( ) 1" bare wire.
- ( ) 1-1/4" bare wire.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) 1N4149 diodes (#56-56) at D8, D10, D12, D6, D4, and D2. Note that three of these diodes face one way and the other three face the opposite direction. Solder the diode leads to the foil and cut off the excess lead lengths. NOTE: If you get solder on a resistor module pin that is on the same foil pad as a diode lead it is alright. Be careful that you do not bridge solder across two foils.



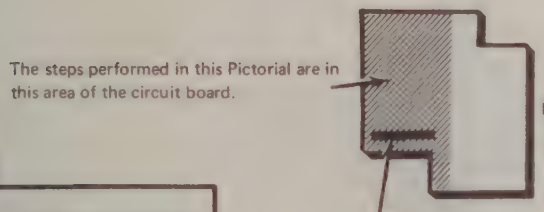
- ( ) 1-1/4" bare wire.
- ( ) 1" bare wire.
- ( ) ZD3: 1N750 zener diode (#56-59).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

- ( ) Male connector pin.
- ( ) Male connector pin.
- ( ) D1: 1N4149 diode (#56-56).
- ( ) ZD5: 1N751 zener diode (#56-16).
- ( ) Male connector pin.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) 3/4" bare wire.
- ( ) ZD2: 1N3017 zener diode (#56-97).
- ( ) 2-1/2" blue solid wire.
- ( ) D17: 1N4002 diode (#57-65).
- ( ) D18: 1N4002 diode (#57-65).
- ( ) D16: 1N4002 diode (#57-65).
- ( ) D15: 1N4002 diode (#57-65).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-3



START

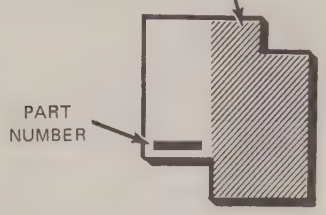
- (✓) R52: 248 Ω (red-yellow-gray-black), or 247.5 Ω 1/2-watt, 1%, precision.
- (✓) R53: 61.1 Ω (blue-brown-brown-gold), 1-watt, 1%, precision.
- (✓) R56: 51.0 Ω (green-brown-black-gold), 1-watt, 1%, precision.
- (✓) R59: 96.3 Ω (white-blue-orange-gold), 1/2-watt, 1% precision.
- (✓) R57: 96.3 Ω (white-blue-orange-gold), 1/2-watt, 1%, precision.
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- (✓) R39: 3600 Ω, 5%, 1/4-watt (orange-blue-red-gold)
- (✓) R58: 71.2 Ω (violet-brown-red-gold), 1-watt, 1% precision.
- (✓) R34: 1000 Ω, 5%, 1/4-watt (brown-black-red-gold).
- (✓) R35: 330 Ω, 5%, 1/4-watt (orange-orange-brown-gold).
- (✓) R37: 47 Ω, 5%, 1/4-watt (yellow-violet-black-gold).
- (✓) R36: 47 Ω, 5%, 1/4-watt (yellow-violet-black-gold).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE

- (✓) R55: 2500 Ω (red-green-black-brown), 1/4-watt, 1%, precision
- (✓) R54: 51.0 Ω (green-brown-black-gold), 1-watt, 1%, precision
- (✓) R51: 61.1 Ω (blue-brown-brown-gold), 1-watt, 1%, precision
- (✓) R46: 15 Ω, 5%, 1/2-watt (brown-green-black-gold).
- (✓) R47: 47 Ω, 5%, 2-watt (yellow-violet-black-gold).
- (✓) R45: 15 Ω, 5%, 1/2-watt (brown-green-black-gold).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- (✓) R44: 1500 Ω, 10%, 1-watt (brown-green-red-silver).
- (✓) R38: 680 Ω, 5%, 1/4-watt (blue-gray-brown-gold)
- (✓) R43: 4700 Ω, 5%, 1/4-watt (yellow-violet-red-gold).
- (✓) R41: 820 Ω, 5% 1/4-watt (gray-red-brown-gold).
- (✓) R42: 18 kΩ, 5%, 1/4-watt (brown-gray-orange-gold).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.

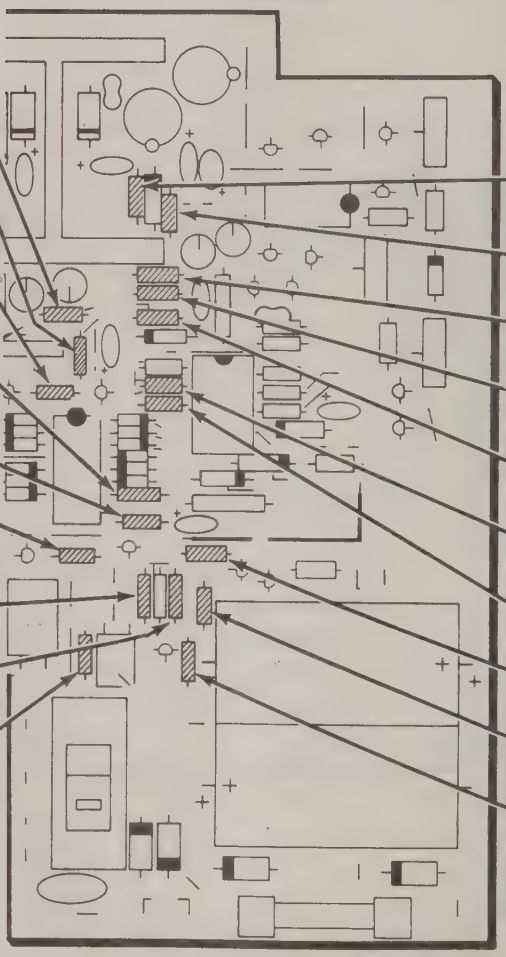
PICTORIAL 1-4

The steps performed in this Pictorial are in this area of the circuit board.



START

- ( ) R31: 150 Ω, 5%, 1/4-watt (brown-green-brown-gold).
- ( ) R28: 8200 Ω, 5%, 1/4-watt (gray-red-red-gold).
- ( ) R27: 1000 Ω (brown-black-black-brown), 1/4-watt, 1%, precision.
- ( ) R29: 4530 Ω (yellow-green-orange-brown), 1/4-watt, 1%, precision.
- ( ) R25: 8200 Ω, 5%, 1/4-watt (gray-red-red-gold).
- ( ) R24: 1000 Ω, (brown-black-black-brown), 1/4-watt, 1%, precision.
- ( ) R67: 14.3 kΩ, (brown-yellow-orange-red), 1/4-watt, 1%, precision.
- ( ) R66: 14.3 kΩ, (brown-yellow-orange-red), 1/4-watt, 1%, precision.
- ( ) R62: 2200 Ω, 5%, 1/4-watt (red-red-red-gold).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

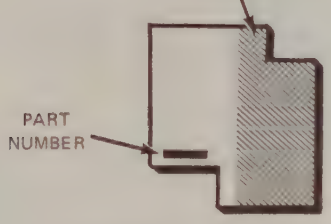


CONTINUE

- ( ) R21: 560 Ω, 5%, 1/4-watt (green-blue-brown-gold).
- ( ) R8: 220 Ω, 5%, 1/4-watt (red-red-brown-gold).
- ( ) R22: 1000 Ω, 5%, 1/4-watt (brown-black-red-gold).
- ( ) R9: 2400 Ω, 5%, 1/4-watt (red-yellow-red-gold).
- ( ) R11: 4700 Ω, 5%, 1/4-watt (yellow-violet-red-gold).
- ( ) R13: 1000 Ω (brown-black-black-brown), 1/4-watt, 1% precision.
- ( ) R14: 14.3 kΩ (brown-yellow-orange-red). 1/4-watt, 1%, precision.
- ( ) R65: 6800 Ω, 5%, 1/4-watt (blue-gray-red-gold).
- ( ) R63: 620 Ω, 5%, 1/4-watt (blue-red-brown-gold).
- ( ) R64: 22 kΩ, 5%, 1/4-watt (red-red-orange-gold).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

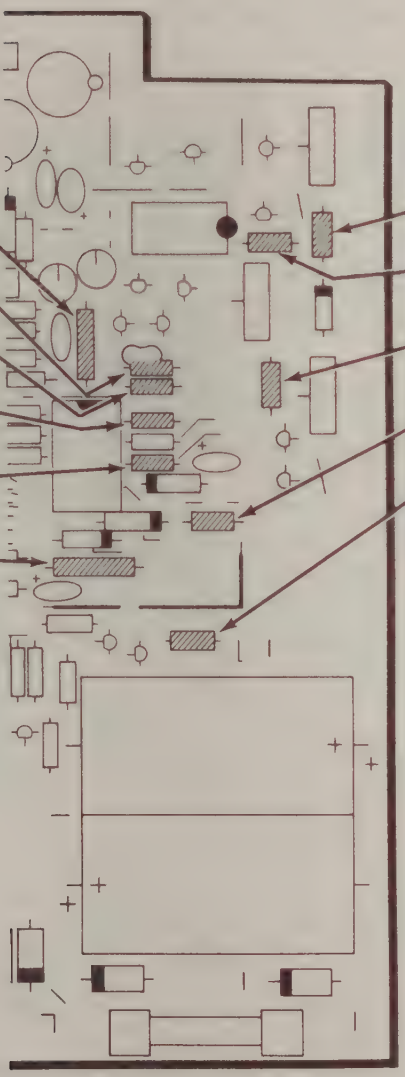
PICTORIAL 1-5

The steps performed in this Pictorial are in this area of the circuit board.



START

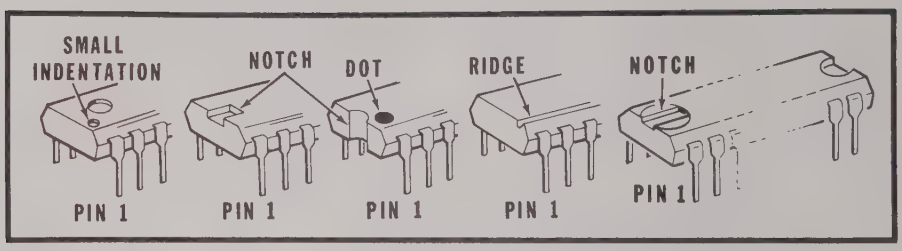
- (√) R15: 510 Ω, 5%, 1/2-watt (green-brown-brown-gold).
- (√) R19: 330 Ω, 5%, 1/4-watt (orange-orange-brown-gold).
- (√) R12: 2200 Ω, 5%, 1/4-watt (red-red-red-gold).
- (√) R16: 1000 Ω (brown-black-black-brown), 1/4-watt, 1% precision.
- (√) R17: 14.3 kΩ (brown-yellow-org-red), 1/4-watt, 1%, precision.
- (√) R18: 330 Ω, 5%, 1-watt (orange-orange-brown-gold).
- (√) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

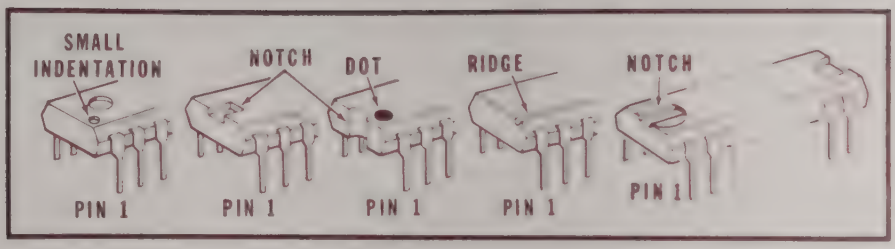
- (√) R3: 2.2 Ω, 5%, 1/4-watt (red-red-gold-gold)
- (√) R1: 2.2 Ω, 5%, 1/4-watt (red-red-gold-gold)
- (√) R5: 47 kΩ, 5%, 1/4-watt (yellow-violet-orange-gold).
- (√) R20: 470 Ω, 5%, 1/4-watt (yellow-violet-brown-gold).
- (√) R61: 150 Ω, 5%, 1/4-watt (brown-green-brown-gold).
- (√) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-6



Detail 1-1A

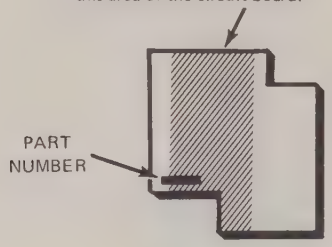
NOTE: Before you install an IC, first be sure the pins are straight. Then lay it down on one of its rows of pins, as shown below at A, and roll it over until the pins are at right angles or are bent in slightly as shown at B. Repeat this process for the other row of pins.



Detail 1-1A

NOTE: Before you install an IC, first be sure the pins are straight. Then lay it down on one of its rows of pins, as shown below at A, and roll it over until the pins are at right angles or are bent in slightly as shown at B. Repeat this process for the other row of pins.

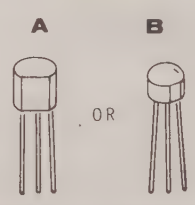
The steps performed in this Pictorial are in this area of the circuit board.



IDENTIFICATION DRAWING

START

NOTE: If the following transistors look like transistor "A" below, refer to Detail 1-7A for installation instructions. If the transistors look like transistor "B" below, refer to Detail 1-7B for installation instructions.



(✓) Q14: 2N4121 transistor (#417-235).

(✓) Q16: 2N4121 transistor (#417-235).

(✓) Q20: MPSA20 transistor (#417-801).

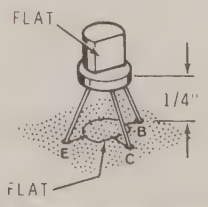
(✓) Q23: MPSA20 transistor (#417-801).

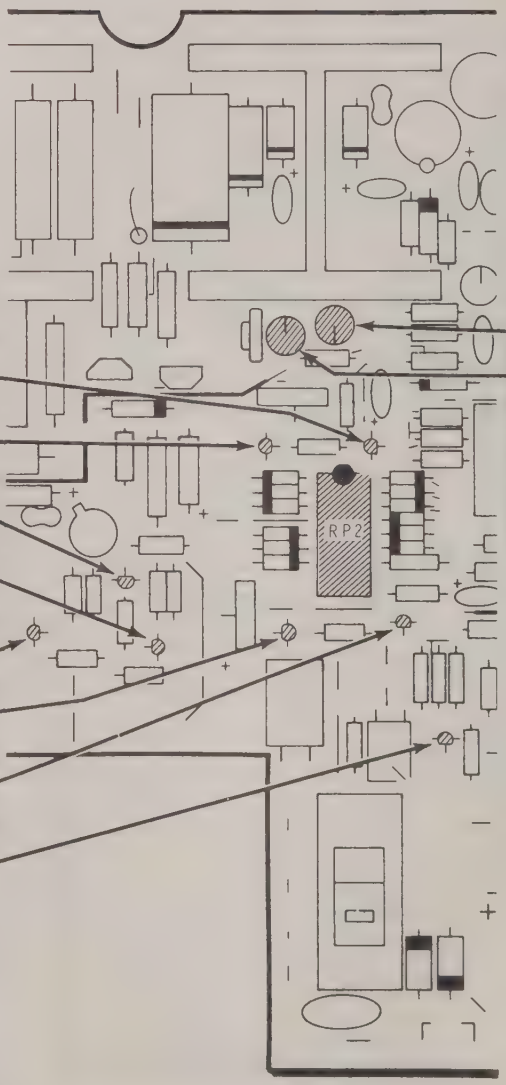
(✓) Q19: MPSA20 transistor (#417-801).

(✓) Q15: MPSA20 transistor (#417-801).

(✓) Q13: MPSA20 transistor (#417-801).

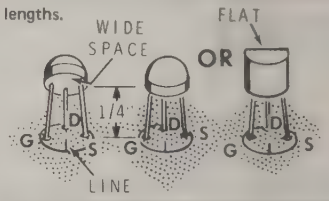
(✓) Q26: X29A829 transistor (#417-201).





CONTINUE

NOTE: When you install the next two transistors, notice the wide space between two of the leads. Position this wide space over the line in the circle on the circuit board. Then insert the leads into their correct G,D, and S holes. Solder the leads to the foil and cut off the excess lead lengths.

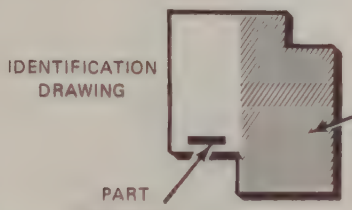


(✓) Q17: Transistor (#417-828).

(✓) Q18: Transistor (#417-828).

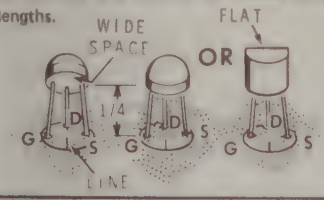
(✓) Solder the pins of resistor module RP2 to the foil at this time. Some of the pins may have become partially soldered as you soldered the diode leads near to the pins.

PICTORIAL 1-7



START

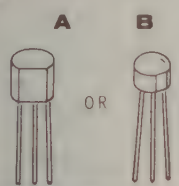
NOTE: When you install the next two transistors, notice the wide space between two of the leads. Position this wide space over the line in the circle on the circuit board. Then insert the leads into their correct G, D, and S holes. Solder the leads to the foil and cut off the excess lead lengths.



( ) Q10: Transistor (#417-828).

( ) Q9: Transistor (#417-828).

NOTE: If the following transistors look like transistor "A" below, refer to Detail 1-7A for installation instructions. If the transistors look like transistor "B" below, refer to Detail 1-7B for installation instructions.



( ) Q27: 2N4121 transistor (#417-235).

( ) Q28: 2N4121 transistor (#417-235).

CONTINUE

( ) Q8: MPSA20 transistor (#417-801).

( ) Q6: MPSA20 transistor (#417-801).

( ) Q3 2N4121 transistor (#417-235)

( ) Q4: 2N5249A transistor (#417-213). Refer to Detail 1-8A on this Page for this step only.

( ) Q7: 2N4121 transistor (#417-235).

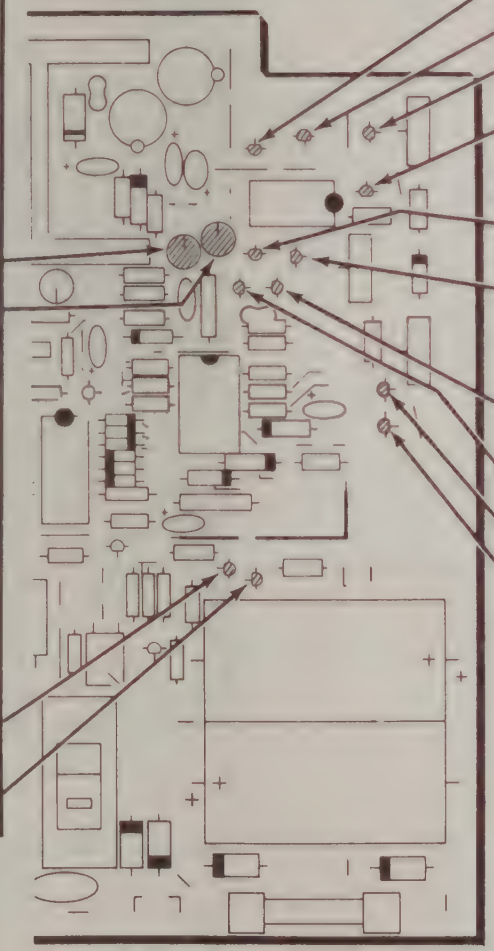
( ) Q5: 2N4121 transistor (#417-235). NOTE: Refer to Detail 1-8B or Detail 1-8C depending on which transistor you received for this step only.

( ) Q11: 2N4121 transistor (#417-235).

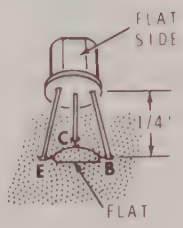
( ) Q12: 2N4121 transistor (#417-235).

( ) Q1 MPSA20 transistor (#417-801).

( ) Q2: 2N4121 transistor (#417-235).

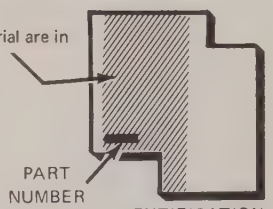


PICTORIAL 1-8



Detail 1-8A

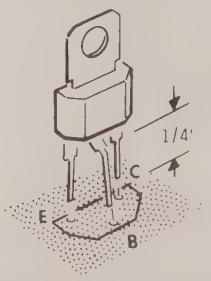
The steps performed in this Pictorial are in this area of the circuit board.



START

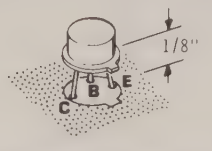
NOTE: The next two transistors are not alike. Do not interchange these transistors.

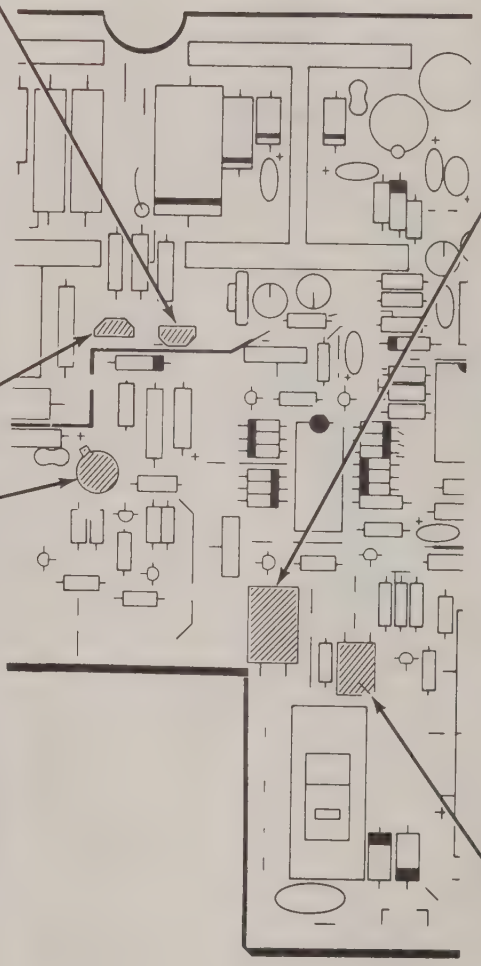
( ) Q24: MPSU55 transistor (#417-225). Line up the transistor with the outline on the circuit board. Then insert the leads through their correct C, B, and E holes. Solder the leads to the foil and cut off the excess lead lengths.



( ) Q22: MPSU05 transistor (#417-224).

( ) Q21: SGC5283 transistor (#417-270). Position the locating tab over the outline of the tab on the circuit board. Then insert the leads into their correct E, B, and C holes. Mount this transistor not more than 1/8" from the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

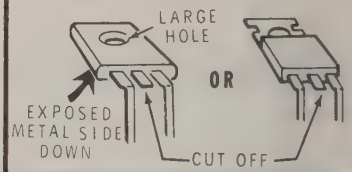




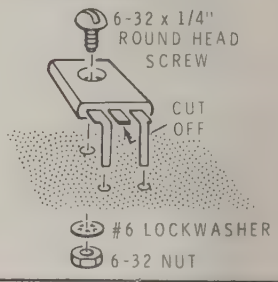
PICTORIAL 1-9

CONTINUE

( ) Locate the UA7815 integrated circuit (#442-63) and cut off the center lead. Then position the integrated circuit with the exposed metal side down and bend the leads down at the wide part.

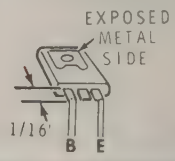


( ) Install the integrated circuit at IC2 with a 6-32 x 1/4" screw, a #6 lockwasher, and a 6-32 nut. Solder the leads to the foil and cut off the excess lead lengths.

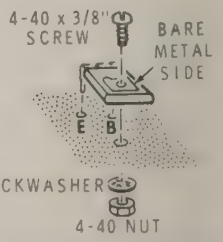


( ) Locate the SJE607 transistor (#417-263) and position it with the exposed metal side up. Then cut off the center lead.

( ) Bend the leads down approximately 1/16" from the transistor body.



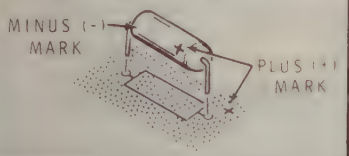
( ) Install the transistor at Q25 with a 4-40 x 3/8" screw, a #4 lockwasher, and a 4-40 nut. Do not overtighten the screw. Solder the leads to the foil and cut off the excess lead lengths.



START

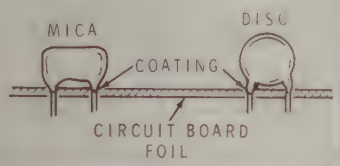
NOTE: Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have a plus (+) mark or a minus (−) mark near it. **Be sure** to install the positive lead in the positive-marked hole. Be careful; only the negative lead may be marked.

( ) C21: 2.2 µF, 50V electrolytic. Be sure to position the plus (+) marked end as shown on the circuit board.



( ) C19: 2.2 µF, 50V electrolytic.

NOTE: When you install disc or mica capacitors on the circuit board, make sure the coating on the leads does not protrude through the board. Solder will not adhere to this coating and a poor connection will result.

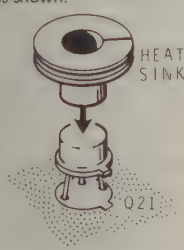


( ) C17: 42 pF mica.

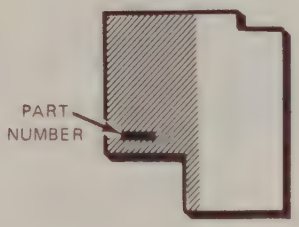
( ) C20: 56 pF mica.

( ) Solder the leads to the foil and cut off the excess lead lengths.

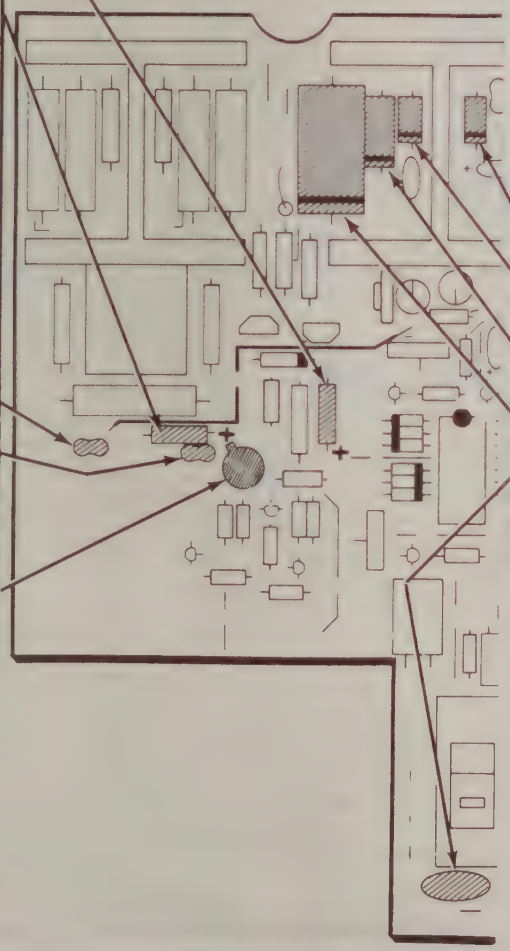
( ) Locate the TO5 heat sink. Push the heat sink down onto transistor Q21 as shown.



IDENTIFICATION DRAWING

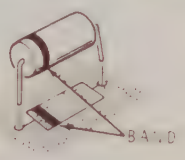


The steps performed in this Pictorial are in this area of the circuit board



CONTINUE

NOTE: When you install the next four capacitors, position the banded end of the capacitor as shown on the circuit board.



( ) C6: .005 µF Mylar. (Part of matched set.)

( ) C7 .05 µF Mylar. (Part of matched set.)

( ) C8: .5 µF Mylar. (Part of matched set.)

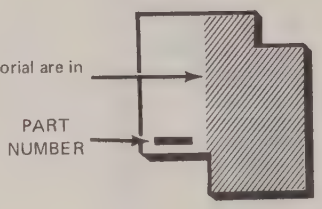
( ) C9: 5 µF Mylar. (Part of matched set.)

( ) C23: .01 µF 1.6 kv disc.

( ) Solder the leads to the foil and cut off the excess lead lengths.

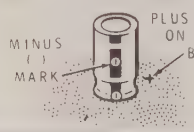
PICTORIAL 1-10

The steps performed in this Pictorial are in this area of the circuit board.



START

NOTE: When you install electrolytic capacitors, be sure to position the capacitor with the minus (−) mark opposite the plus (+) mark shown on the circuit board.



( ) C18: 10 μF.

( ) C15: 10 μF.

( ) C2: 10 μF.

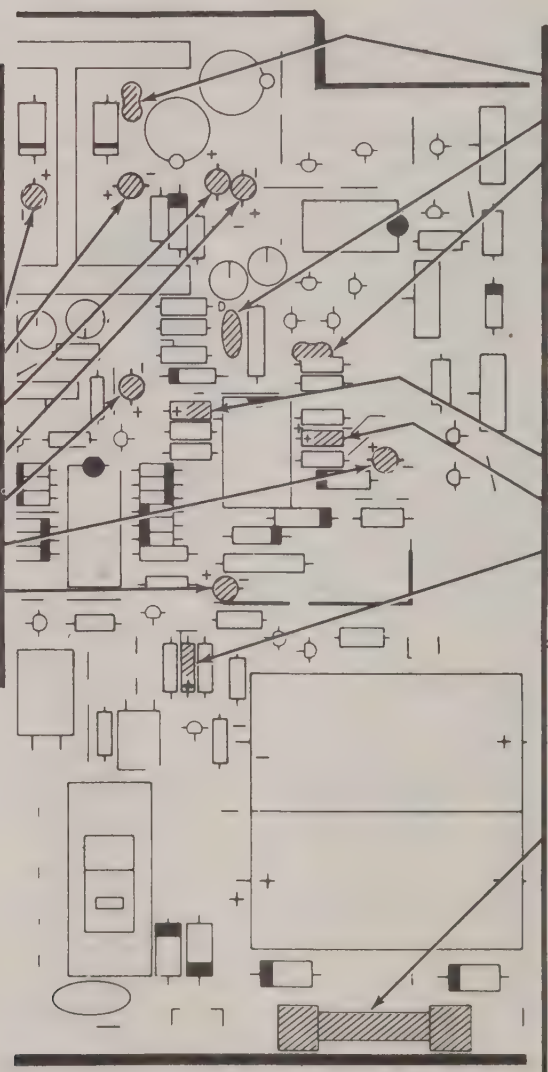
( ) C1: 10 μF.

( ) C28: 10 μF.

( ) C14: 10 μF.

( ) C27: 10 μF.

( ) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

( ) C5: 430 pF mica.

( ) C11: 15 pF disc.

( ) C16: 42 pF mica.

NOTE: When you install the following tantalum capacitors, be sure to position the plus (+) marked end as shown on the circuit board.

( ) C12: 2.2 μF tantalum.

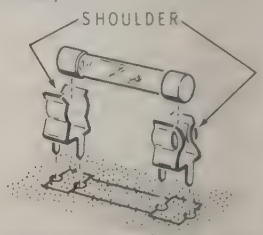
( ) C13: 2.2 μF tantalum.

( ) C26: 2.2 μF tantalum.

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) Install fuse clips in the following manner, place a fuse clip into the circuit board at each end of the fuse outline. Be sure the shoulders of the clips are at the outer end as shown.

( ) Install the 1/4 – ampere fuse (#421-33) into the pair of clips. Then solder all four clip lugs to the foil. Do not apply too much heat to the fuse clip lugs or the fuse may be damaged.



PICTORIAL 1-11

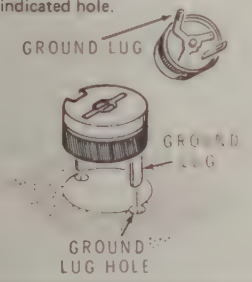
IDENTIFICATION DRAWING

The steps performed in this Pictorial are in this area of the circuit board.

START

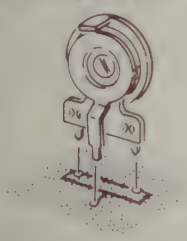
NOTE: As you install the following parts, solder them to the foil.

( ) C3: 8-50 pF trimmer. First look at the bottom of the trimmer and identify the ground lug. Be sure to install the ground lug in the indicated hole.



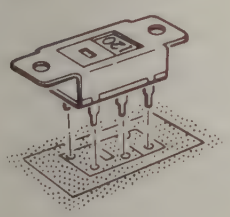
( ) C4: 10-75 pF trimmer. Install this in the same manner as above.

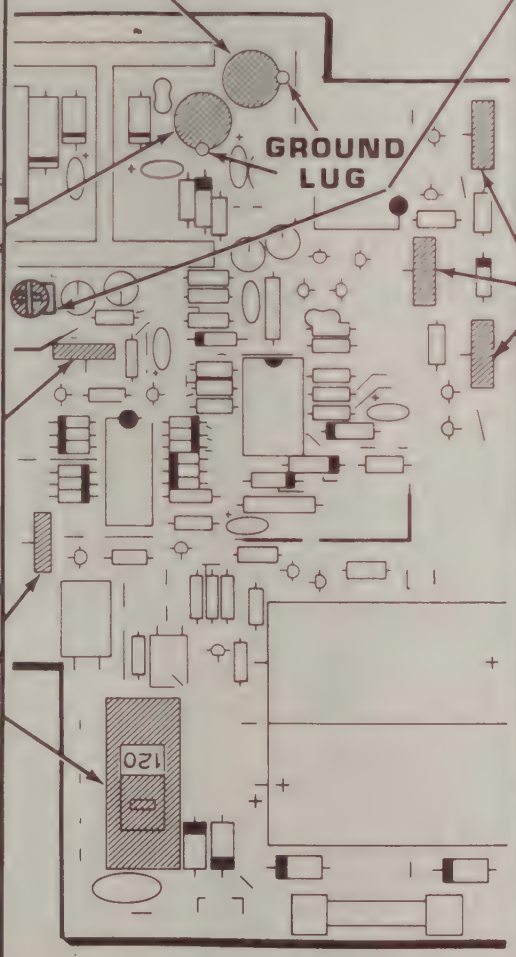
( ) R26: 2000 Ω (2 k) control (#10-398). Do not solder the lug with no foil around it.



( ) R23: 2000 Ω (2k) control (#10-398).

( ) SW4: 120-240 slide switch. Position the switch slider so the 120 is visible. Then position the switch as shown in the Pictorial.





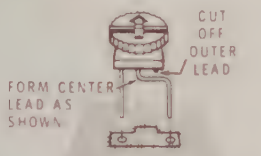
PICTORIAL 1-12

CONTINUE

( ) Locate the 500 Ω control with leads (#10-1174)

( ) Position the control as shown and cut off the indicated outer lead

( ) Form the center lead as shown



( ) R32: Mount the 500 Ω control as down against the circuit board as it is shown in the pictorial on the left

NOTE: As you install the following parts, solder them to the foil.

( ) R4: 750 Ω control (#10-295)

( ) R7: 300 Ω control (#10-949)

( ) R2: 1000 Ω control (#10-936)

CIRCUIT BOARD CHECKOUT

( ) Check all diodes to make sure they are positioned with their banded ends as shown on the circuit board.

( ) Check all electrolytic and tantalum capacitors to make sure they are positioned with their plus (+) marked leads as shown on the circuit board.

( ) Check all transistors to make sure they are correctly installed and that none of the transistors have been interchanged.

( ) Check the resistor modules and the IC (integrated circuit) for proper positioning on the circuit board.

( ) Check for poorly soldered connections and for solder bridges (solder that crosses from one foil to another).

( ) Cut off any long leads or pins that could cause a short to the circuit board or to the cabinet after the circuit board is installed.

NOTE: You may discard the left-over 150 Ω resistor.

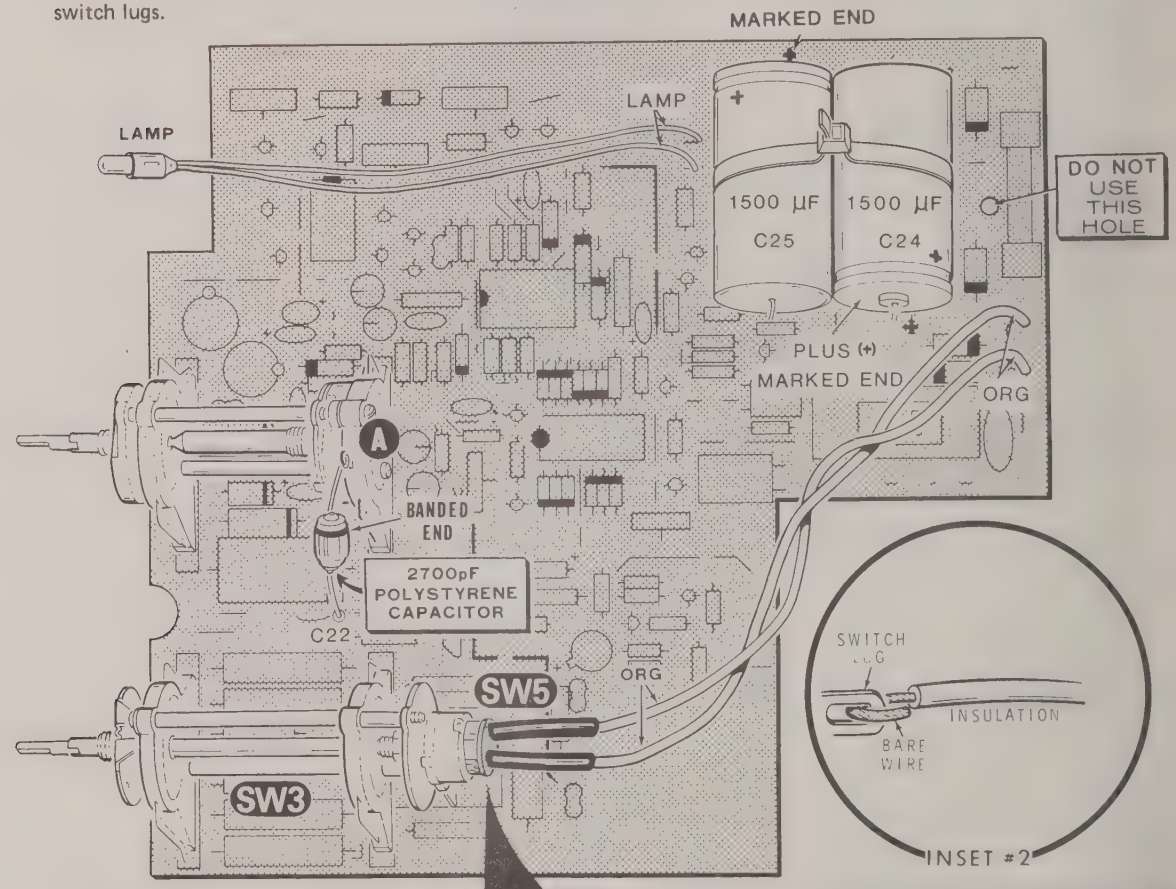
CIRCUIT BOARD

Refer to Pictorial 1-13 for the following steps.

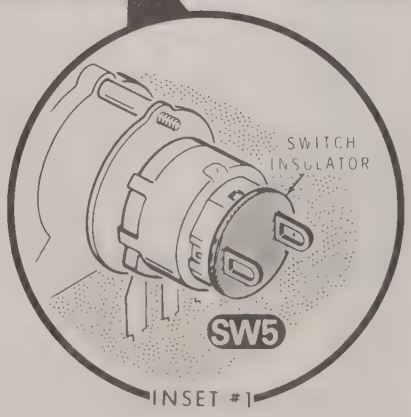
( ) Refer to Detail 1-13A and solder the rotary switch with variable control to the circuit board at SW3 in the following manner. First solder only the four corner lugs. Then make sure that the switch is setting flush on the circuit board and solder the remaining switch lugs.

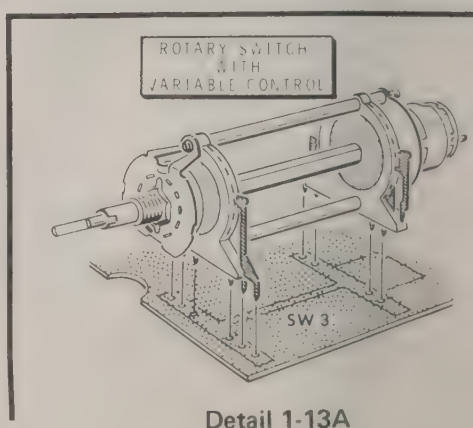
( ) In a similar manner, solder the other rotary switch to the circuit board at SW1/SW2.

( ) Connect the .0027 µF (2700 pF) polystyrene capacitor from lug A on switch SW2 to hole C22 on the circuit board. Position this capacitor so that the leads will not touch the other switch lugs. Solder both capacitor leads.

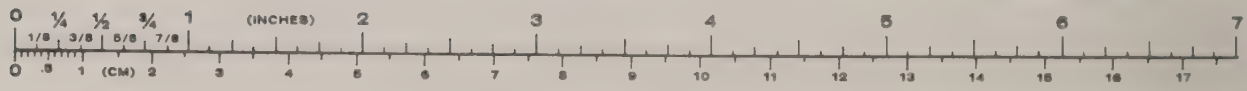


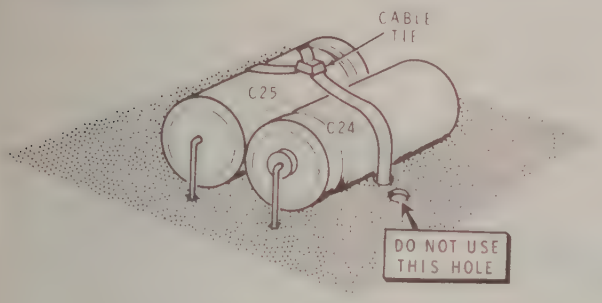
PICTORIAL 1-13





Detail 1-13A





Detail 1-13B

( ) Locate both 1500 μF electrolytic capacitors. Install these on the circuit board at C24 and C25. Be sure to position the plus (+) marked end of each capacitor as shown. Do not solder the leads to the foil at this time.

( ) Refer to Detail 1-13B and thread the nylon cable tie through the holes in the circuit board and around capacitors C24 and C25. Make sure the rough side of the cable tie is toward the capacitors. Then pull the cable tie tight and cut off the excess lead length.

( ) Solder the leads of both electrolytic capacitors to the foil and cut off the excess lead lengths.

NOTE: When you prepare stranded wire, as in the next step, cut the wire to the specified length and remove 1/4" of insulation from each end. Then tightly twist the wire strands at each end so the small wire strands are held together.

( ) Prepare two 8" large orange stranded wires.

( ) See that the switch insulator shown in inset drawing #1 is in place on the back of switch SW5. If this insulator has come off, locate it and place it over the switch lugs.

NOTE: In the following step, it is important that you make the connections to the switch lugs mechanically secure and as neat as possible so that sleeving will go over the lugs. Refer to inset drawing #2 and insert the bare end of the wire through the lug and fold the wire back over itself. Do not fold the bare wire back over the insulated part of the wire or the sleeving will not pass over the lug.

( ) Solder one of the large orange stranded wires to each lug on the back of switch SW5.

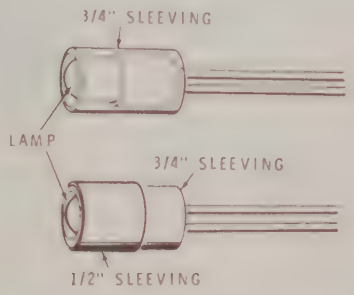
( ) Cut two 1" lengths of small sleeving. Then slide one length of sleeving over the loose end of each orange wire.

( ) Slide the sleeving on each orange wire over the connections on the back of switch SW5 so the switch lugs are covered.

( ) Loosely twist the two large orange stranded wires together.

( ) Solder one end of each orange wire to the foil at the holes marked ORG. Make sure all the fine wire strands go through the circuit board hole. Cut off any any excess wire lengths.

( ) Locate the large sleeving and cut a 3/4" length and a 1/2" length.



Detail 1-13C

( ) Refer to Detail 1-13C and place the 3/4" sleeving over the pilot lamp until the sleeving is flush with the end of the lamp.

( ) Hold the lamp and sleeving near a heat source such as a 100-watt light bulb to shrink the sleeving.

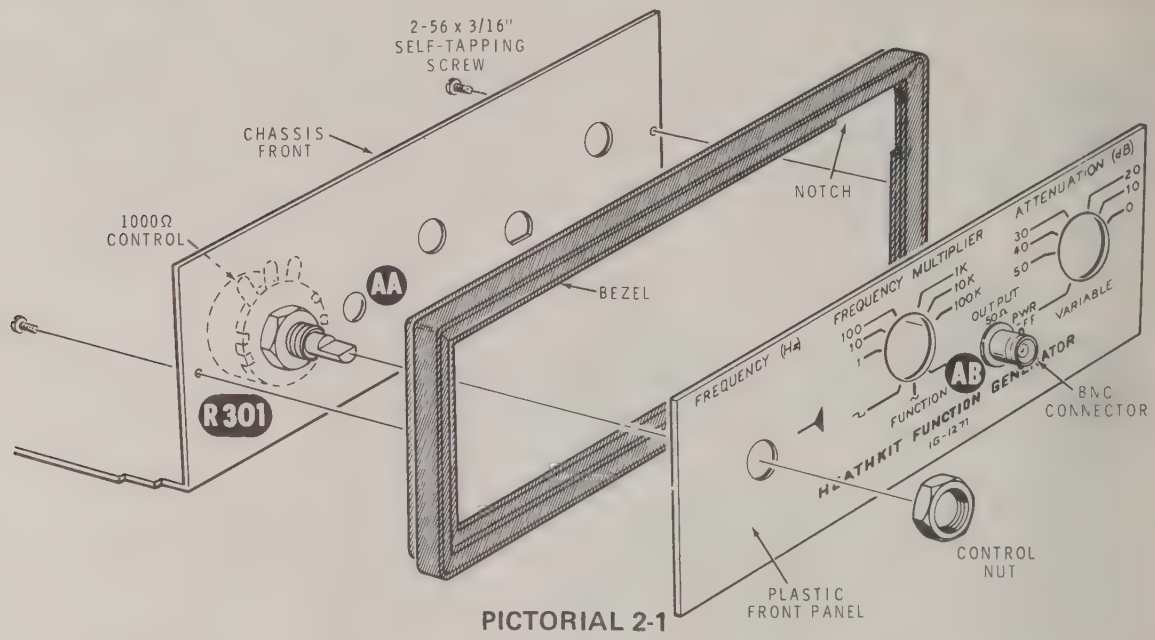
( ) Now slide the 1/2" sleeving over the lamp until the sleeving is flush with the end of the lamp.

( ) Again place the lamp and sleeving near a heat source to shrink this sleeving.

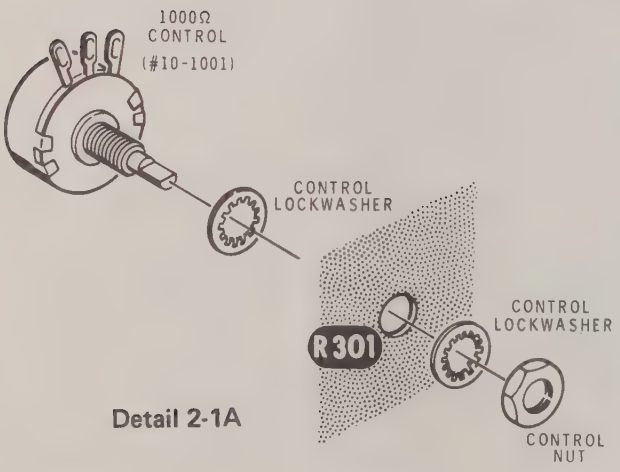
( ) Twist the fine wire strands at the end of each lamp lead. Then apply a small amount of solder to the bare ends to hold the strands in place.

( ) Insert the lamp leads through the circuit board holes marked LAMP. Solder both leads to the foil.

This completes the assembly of your circuit board. Lay the circuit board aside.



PICTORIAL 2-1



Detail 2-1A

(✓) Refer to Detail 2-1A and mount the 1000 Ω control (#10-1001) to the chassis front at R301. Use two control lockwashers and a control nut.

(✓) Locate the plastic front panel and the BNC connector. If the plastic front panel is covered with a plastic film, remove the film. Then wash the plastic front panel.

(✓) Refer to Detail 2-1B and install the BNC connector in the plastic front panel at AB. Use the hardware that is supplied with the connector. Position the flat on the BNC connector so it is parallel with the bottom of the front panel. Then tighten the hardware only finger tight.

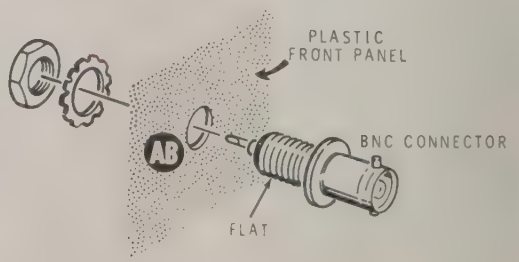
(✓) Mount the plastic front panel onto the chassis front with a control nut at R301.

FRONT PANEL

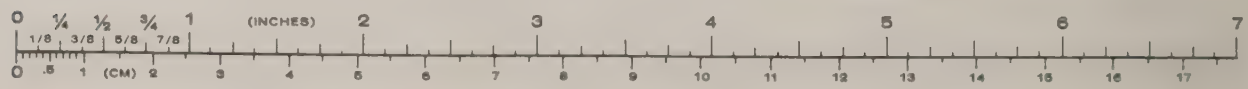
Refer to Pictorial 2-1 for the following steps.

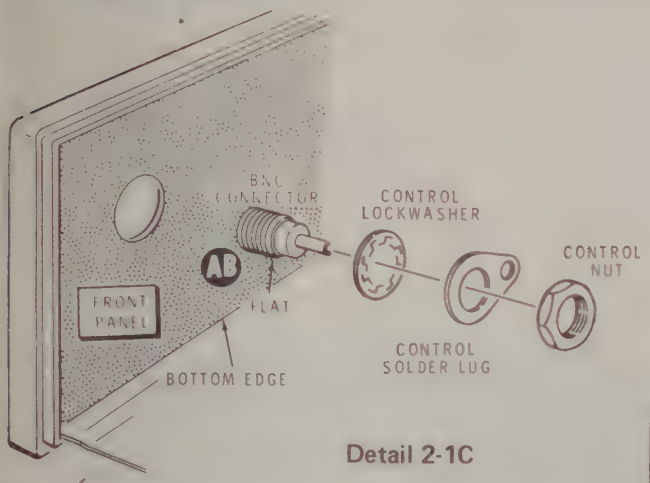
(✓) Mount the bezel (#210-89) to the chassis front with two 2-56 x 3/16" self-tapping screws. Position the side of the bezel with the part number on it toward the chassis with the notch in the upper corner away from the control as shown. Do not overtighten these screws.

(✓) Install the rubber grommet in hole AA in the chassis front.



Detail 2-1B





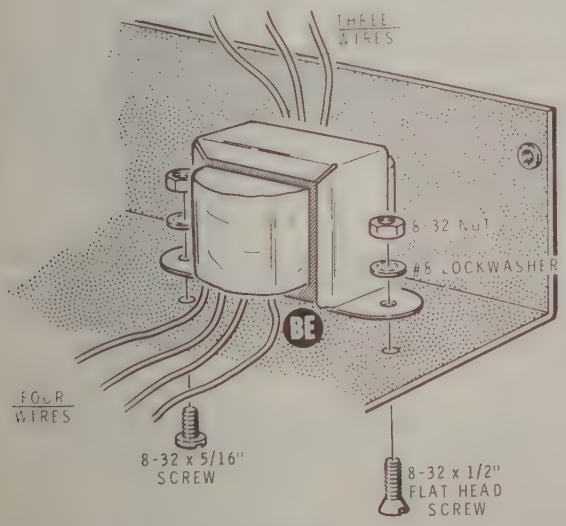
Detail 2-1C

( ) Refer to Detail 2-1C and secure the BNC connector to the back of the chassis front with a control lockwasher, a control solder lug, and a control nut. Position the solder lug as shown; then tighten the hardware securely.

Refer to Pictorial 2-2 (fold-out from Page 27) for the following steps.

( ) Mount 5/8" spacers in the chassis at BA, BB, BC, and BD. Use a 6-32 x 3/8" black screw and a #6 lockwasher for each spacer.

( ) Refer to the inset drawing and mount a #6 solder lug to the inside of the chassis back at CA. Use a 6-32 x 3/8" black screw and a 6-32 nut.

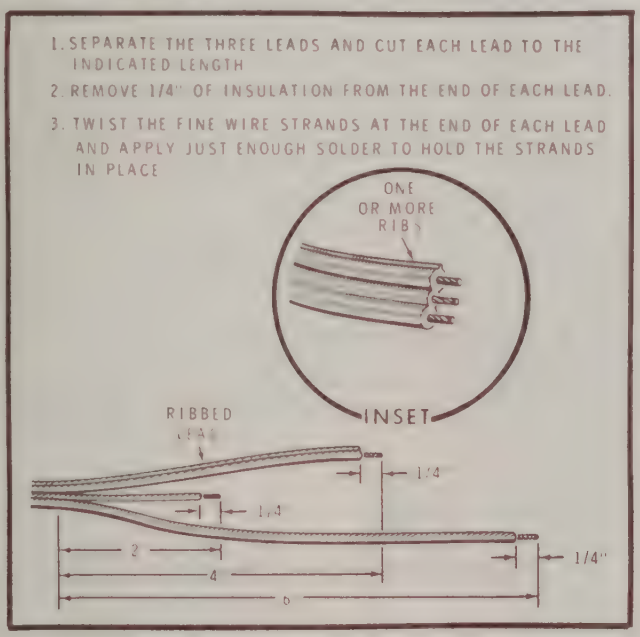


Detail 2-2A

( ) Locate the following hardware. This hardware will be used to mount the power transformer in the next step.

QTY.	DESCRIPTION
1	8-32 x 5/16" screw
1	8-32 x 1/2" flat head screw
2	8-32 nut
2	#8 lockwasher

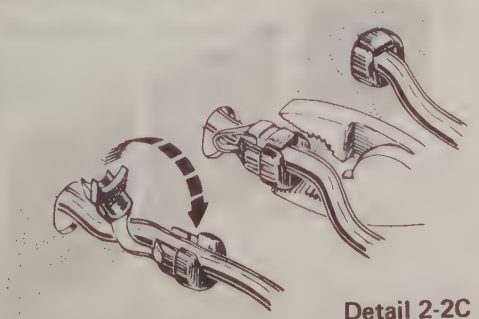
( ) Refer to Detail 2-2A and mount the power transformer to the chassis at BE. Make sure that the leads are positioned as shown. Note the location of the flat head screw.


1. SEPARATE THE THREE LEADS AND CUT EACH LEAD TO THE INDICATED LENGTH
2. REMOVE 1/4" OF INSULATION FROM THE END OF EACH LEAD.
3. TWIST THE FINE WIRE STRANDS AT THE END OF EACH LEAD AND APPLY JUST ENOUGH SOLDER TO HOLD THE STRANDS IN PLACE
ONE OR MORE RIBS
INSET
RIBBED LEAD
1/4
1/4
2
4
6
1/4"

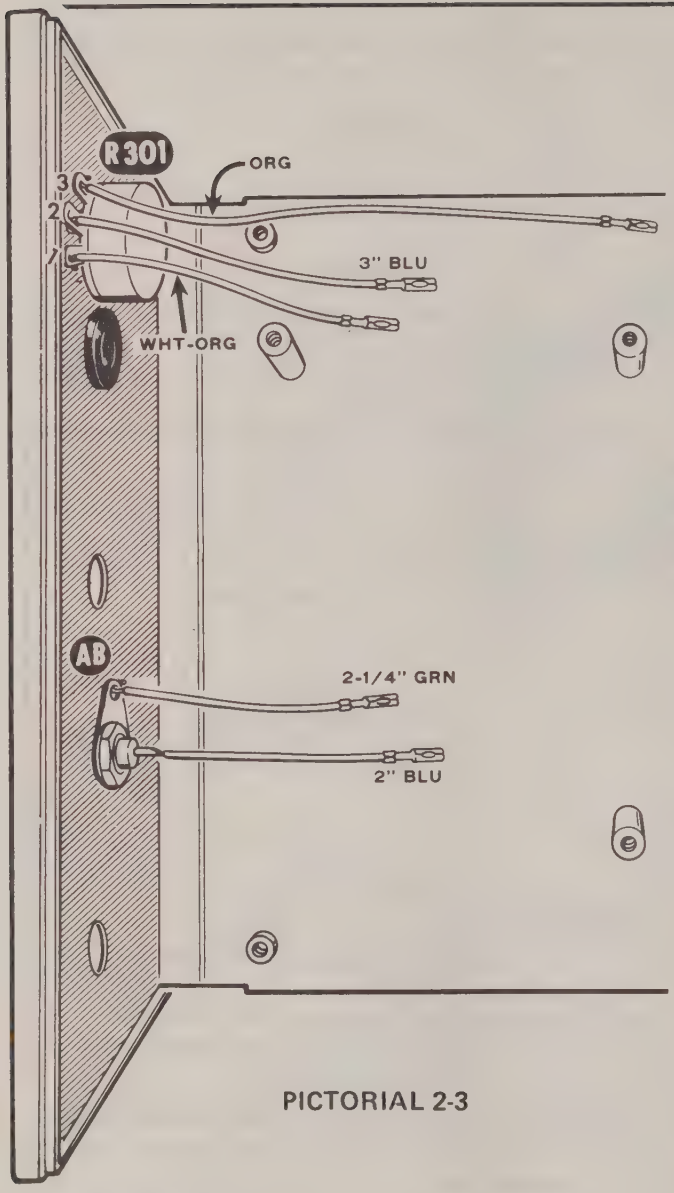
Detail 2-2B

( ) Refer to Detail 2-2B and prepare the end of the line cord. Note that one lead has one or more ribs molded along the lead.

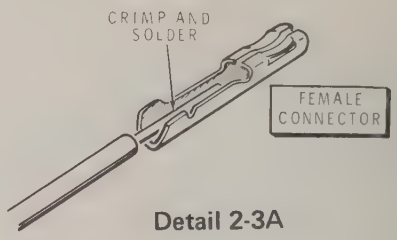
( ) Refer to Detail 2-2C and install the strain relief and the line cord at CB. Position the strain relief on the line cord where the leads separate.



Detail 2-2C



PICTORIAL 2-3



Detail 2-3A

CHASSIS WIRING

Refer to Pictorial 2-3 for the following steps.

(✓) Prepare the following small stranded wires. Twist the fine wire strands at the end of each wire. Then apply just enough solder to hold the strands in place.

2-1/4" green	3" blue
2" blue	4-1/2" orange
2-1/2" white-orange	

(✓) Refer to Detail 2-3A and install a female connector on one end of each of the small stranded wires.

NOTE: In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number, such as (S-3) means to solder the connection. The number following the "S" tells how many wires are at the connection.

(✓) Connect the 2-1/4" green small stranded wire to solder lug AB (S-1).

(✓) Connect the 2" blue small stranded wire to the center pin of BNC connector AB (S-1).

(✓) Connect the 2-1/2" white-orange small stranded wire to control R301 lug 1 (S-1).

(✓) Connect the 3" blue small stranded wire to lug 2 of control R301 (S-1).

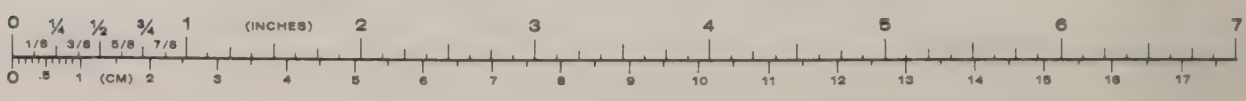
(✓) Connect the 4-1/2" orange small stranded wire to lug 3 of control R301 (S-1).

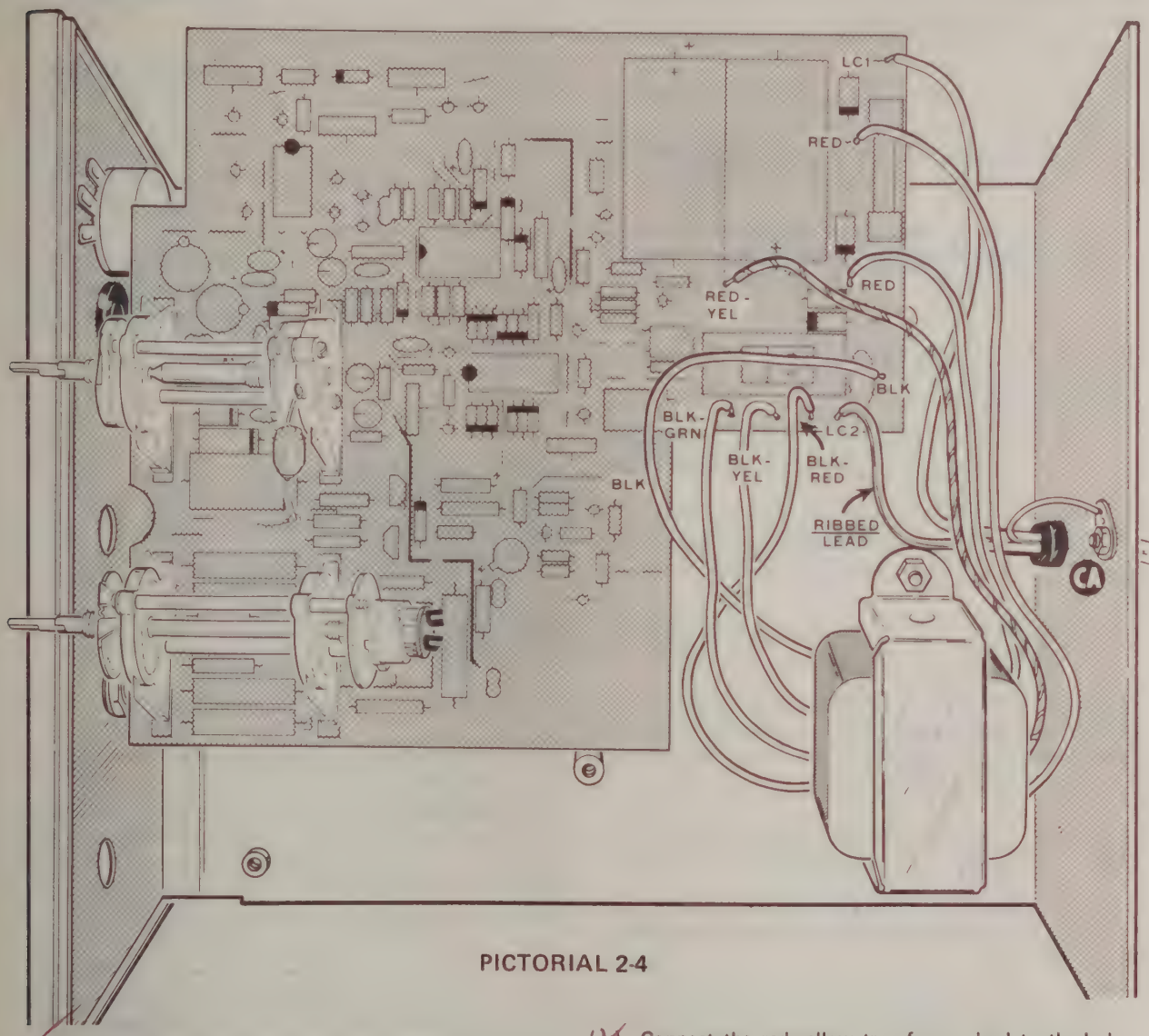
Refer to Pictorial 2-4 for the following steps.

(✓) Connect the green line cord lead to the solder lug at CA (S-1). Insert the wire through the lug and then crimp it securely to the lug before you solder it.

NOTE: In the following steps, the line cord and power transformer leads will be connected to the circuit board. Do not shorten any of these leads. They must be long to allow for circuit board installation later.

( ) Position the circuit board on top the chassis as shown. The circuit board can be turned over for soldering.





PICTORIAL 2-4

(✓) Connect the ribbed line cord lead to hole LC2 (S-1).

(✓) Connect the other line cord lead to hole LC1 (S-1).

(✓) Connect the black transformer lead to the hole marked BLK (S-1).

(✓) Connect either red transformer lead to either hole marked RED (S-1).

(✓) Connect the remaining red transformer lead to the other hole marked RED (S-1).

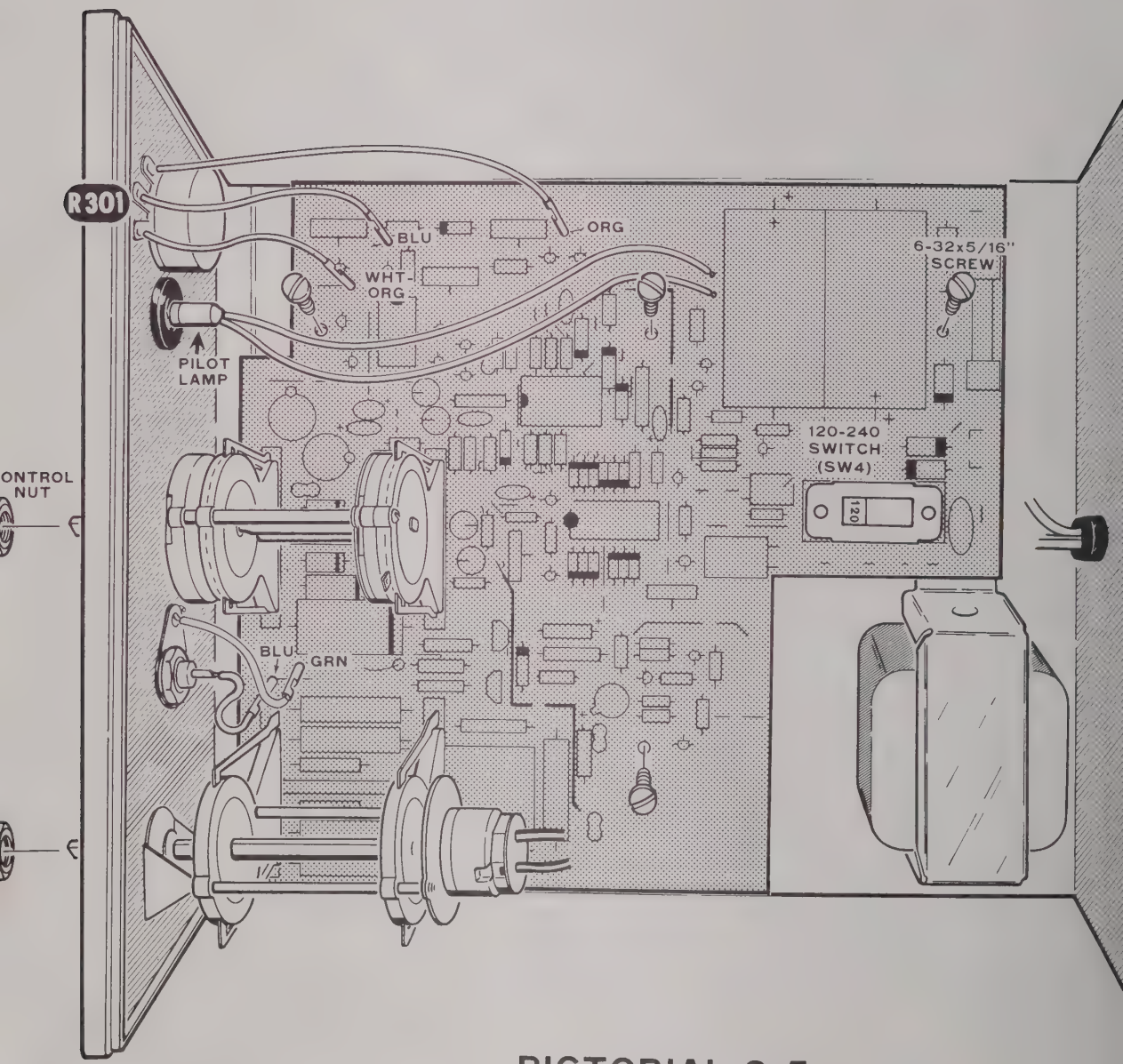
(✓) Connect the red-yellow transformer lead to the hole marked RED-YEL (S-1).

(✓) Connect the black-red transformer lead to the hole marked BLK-RED (S-1).

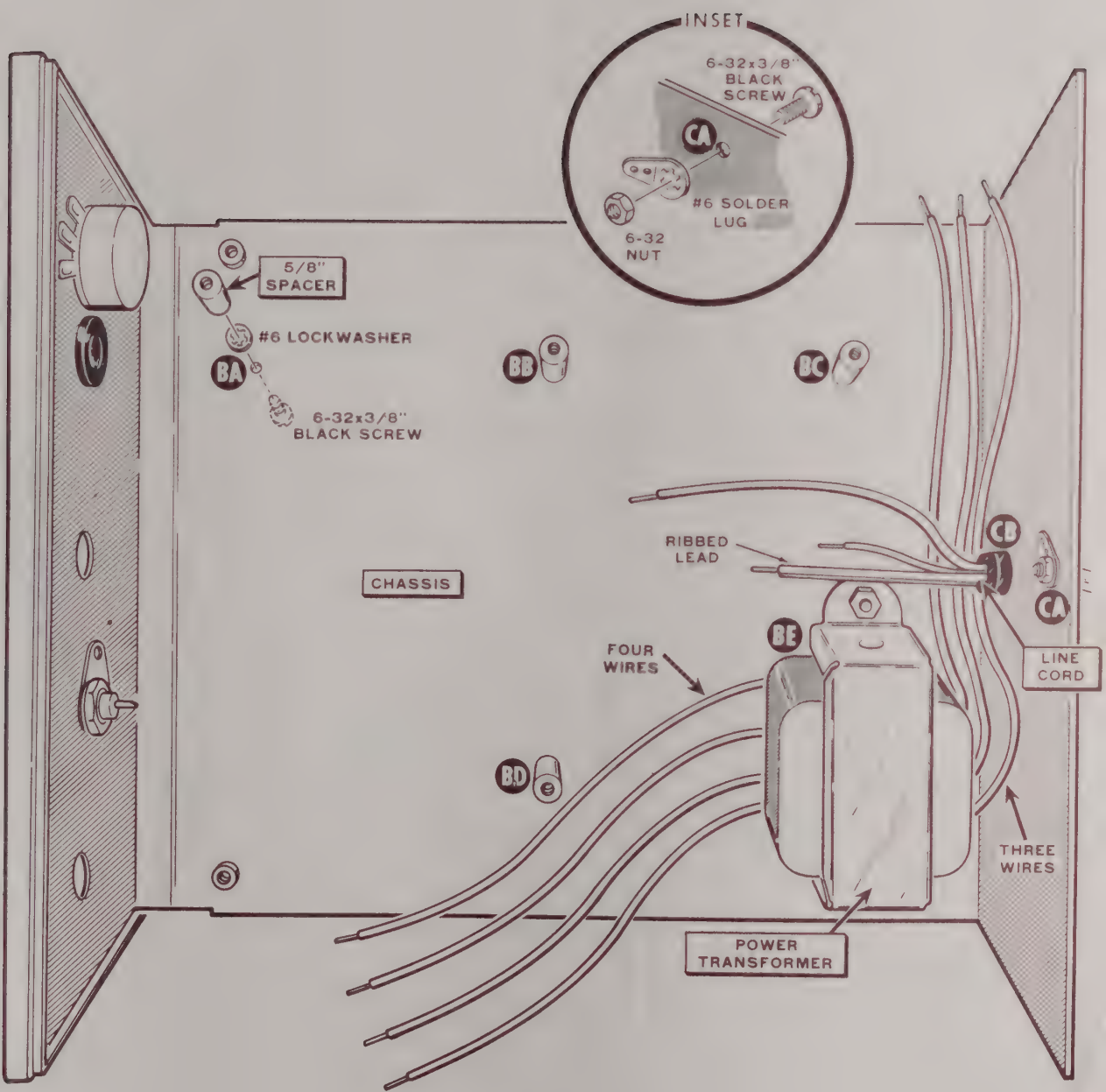
(✓) Connect the black-yellow transformer lead to the hole marked BLK-YEL (S-1).

(✓) Connect the black-green transformer lead to the hole marked BLK-GRN (S-1).

(✓) Cut off any excess lead lengths on the foil side of the circuit board.



PICTORIAL 2-5



PICTORIAL 2-2

Refer to Pictorial 2-5 (fold-out from this page) for the following steps.

( ) Mount the circuit board to the chassis as follows:

1. Position the five wires coming from the front panel up out of the way.
2. Raise the back of the circuit board above the chassis back panel. This will allow you to start the rotary switch shafts through the front panel holes.
3. Slide the circuit board forward while lowering the back of the circuit board into the chassis.
4. Mount the circuit board to the four spacers with four 6-32 x 5/16" screws. Do not tighten these screws.
5. Secure both rotary switch shafts to the front panel. Use a control nut on each shaft.
6. Tighten the four screws that hold the circuit board.

In the following steps, push the female connectors on the ends of the small stranded wires coming from the front panel onto the male connector pins on the circuit board. Do not solder these connectors.

( ) Blue wire coming from the BNC connector to the pin marked BLU.

( ) Green wire coming from the BNC solder lug to the pin marked GRN.

( ) White-orange wire coming from R301 to the pin marked WHT-ORG.

( ) Blue wire coming from R301 to the pin marked BLU.

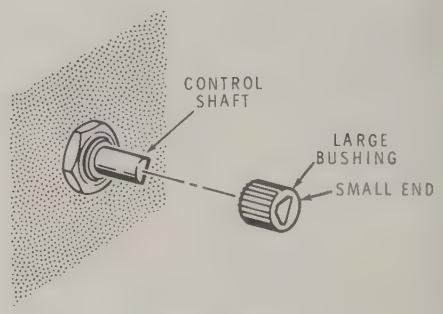
( ) Orange wire coming from R301 to the pin marked ORG.

( ) Push the pilot lamp into the rubber grommet in the front panel.

120 VAC-240 VAC OPERATION

Your Function Generator is designed to operate from either a 120 VAC or a 240 VAC power source. Switch SW4 (120-240 switch) should be in the 120 (120 VAC) position at this time. If you intend to use the Generator on a 240 VAC power source, move switch SW4 so that 240 (240 VAC) is exposed. Also replace the 1/4-ampere fuse with the 1/8-ampere fuse for 240 VAC operation.

WARNING: Operating the Function Generator from a 240 VAC power source while the 120-240 switch is in the 120 position will damage the Generator.



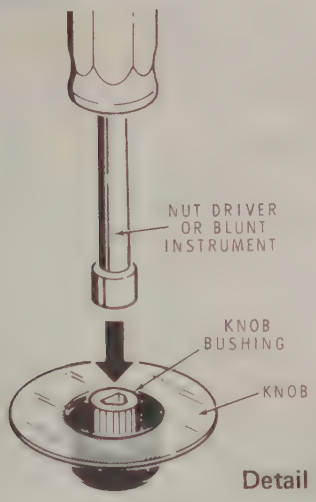
Detail 2-6A

Refer to Pictorial 2-6 for the following steps.

Notice that each of the knob bushings is tapered. Be sure, as you install each bushing on a shaft, that the small end is facing out or the knob will not slide onto it. (Roll the bushing on a flat surface if you are unsure about it; the bushing will gradually turn toward the small end.)

( ) Locate the large bushing with the large hole (#455-50) and push it onto the Frequency control shaft as shown in Detail 2-6A. Make sure the Frequency control shaft is turned fully counterclockwise.

NOTE: In the following steps you will install the knobs. First, position the knobs so their pointers line up with the markings on the front panel. Then push the knob onto the knob bushing to start it into the knob. Remove the knob and bushing and fully seat the bushing into the knob. Once the bushing is seated, IT CANNOT BE REMOVED. Therefore, be sure the knob is properly positioned as shown in Pictorial 2-6.



Detail 2-6B

( ) Make sure the Frequency control shaft is fully counterclockwise. Then position the frequency knob so the calibration mark on the knob lines up with the triangle on the front panel. Then push the knob onto the bushing to start the bushing into the knob.

( ) Refer to Detail 2-6B and remove the knob and bushing. Then press the bushing into the knob.

( ) Replace the frequency knob onto the control shaft.

( ) Place a bushing with a large hole onto the outer shafts of the Frequency Multiplier and Attenuation (dB) shafts. Make sure both of these shafts are fully counterclockwise.

( ) Place one black knob onto the Frequency Multiplier control shaft with the pointer at the "1" position. Then push the knob onto the bushing to start it into the knob.

( ) Remove the knob and bushing, and press the bushing into the knob. Then replace the knob.

( ) Place the other black knob onto the Attenuation control shaft with the pointer in the "50" position. Then push the knob onto the bushing to start it into the knob.

( ) Remove the knob and bushing and press the bushing into the knob. Then replace the knob.

( ) Place the remaining two bushings onto the inner shafts of the Function and Variable shafts. Make sure the shafts are fully counterclockwise. Note that you can hear a click when you turn the variable shaft to its full counterclockwise position.

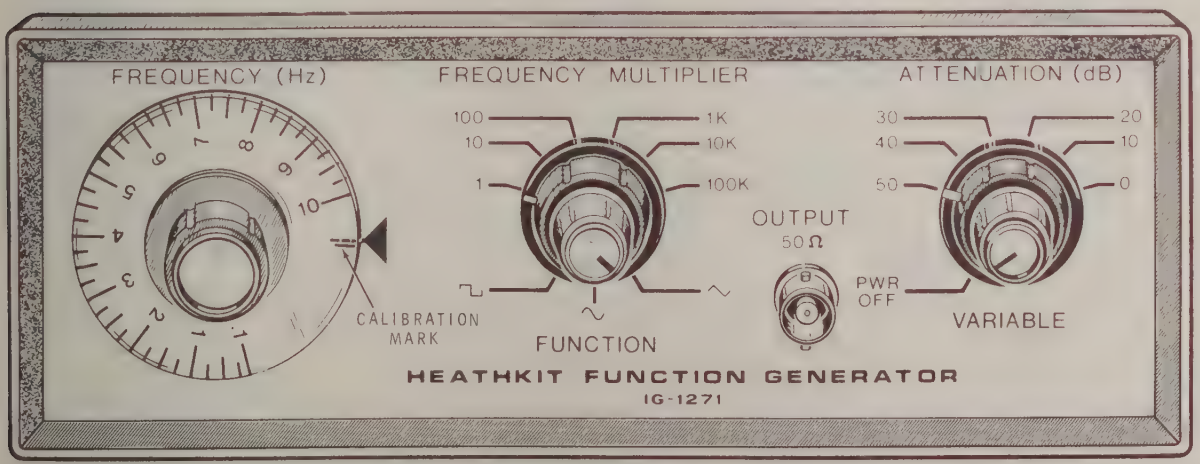
( ) Place a red knob onto the Function control shaft with the pointer in the "∿" position. Then push the knob onto the bushing to start it into the knob.

( ) Remove the knob and bushing and press the bushing into the knob. Then replace the knob.

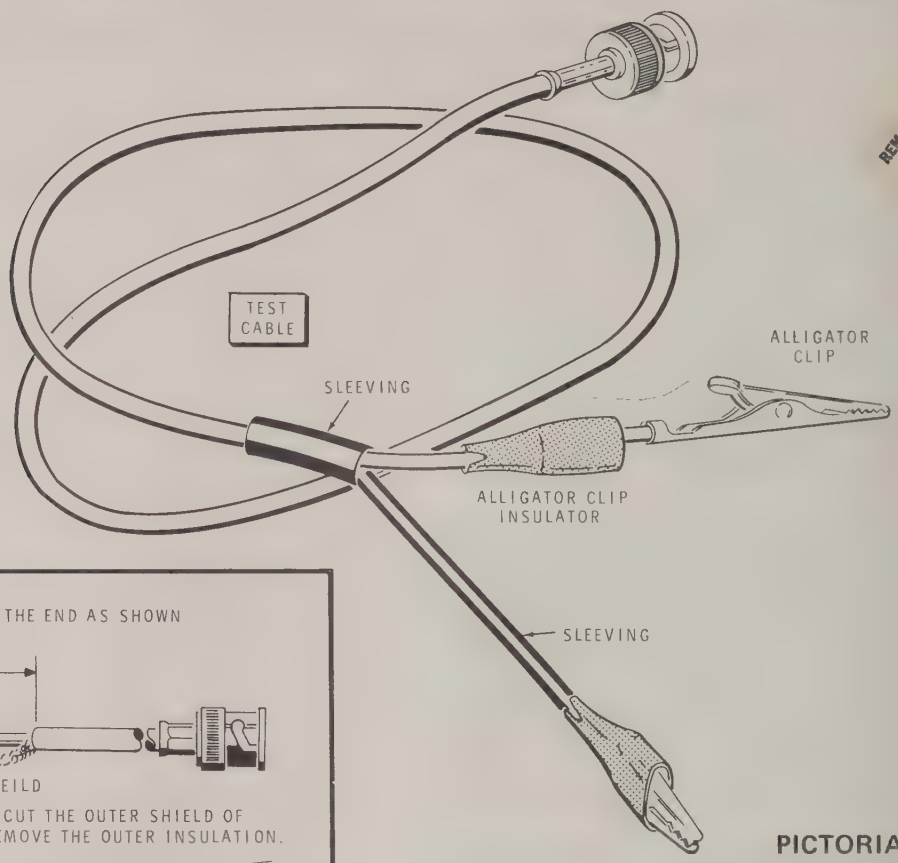
( ) Place the other red knob onto the Variable control shaft with the pointer positioned in the PWR OFF position as shown in the Pictorial. Then push the knob onto the bushing to start the bushing into the knob.

( ) Remove the knob and bushing and press the bushing into the knob. Then replace the knob.

This completes the assembly of your Function Generator. Set it aside temporarily and proceed to "Test Cable Assembly."

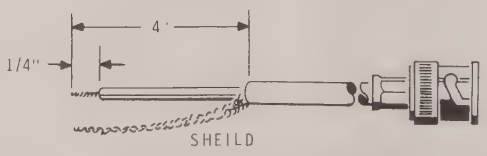


PICTORIAL 2-6

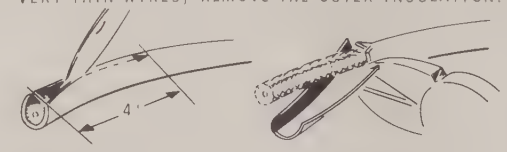


PICTORIAL 2-7

PREPARE THE END AS SHOWN

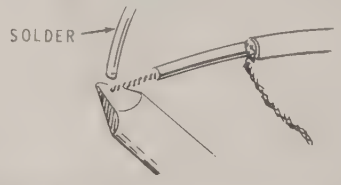


TAKING CARE NOT TO CUT THE OUTER SHIELD OF VERY THIN WIRES, REMOVE THE OUTER INSULATION.

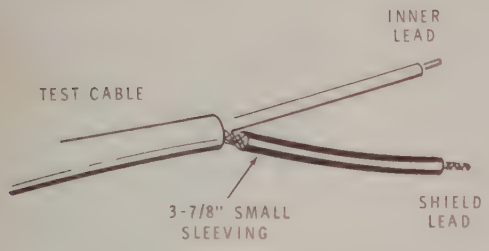


PUSH BACK THE SHIELD. THEN MAKE AN OPENING IN THE SHIELD AND BEND OVER AS SHOWN. PICK OUT THE INNER LEAD.

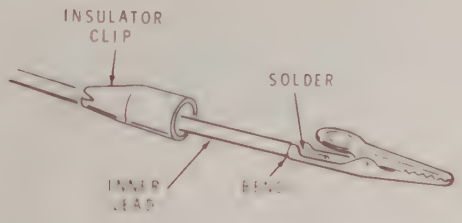
REMOVE THE INNER INSULATION AND STRETCH OUT THE SHIELD. APPLY A SMALL AMOUNT OF SOLDER TO THE END OF THE SHIELD AND THE INNER LEAD. USE ONLY ENOUGH HEAT FOR THE SOLDER TO FLOW.



Detail 2-7A



Detail 2-7B



Detail 2-7D

TEST CABLE ASSEMBLY

Refer to Pictorial 2-7 for the following steps.

( ) Refer to Detail 2-7A and prepare the indicated end of the test cable.

( ) Cut a 3-7/8" length of small sleeving.

( ) Refer to Detail 2-7B and slide the small sleeving over the shield lead of the test cable. Then hold the sleeving near a hot 100-watt light bulb to shrink the sleeving. Rotate the cable slowly to shrink the sleeving evenly.

( ) Cut a 1-1/2" length of large sleeving.

( ) Refer to Detail 2-7C and slide the large sleeving over the test cable until it is centered over the place where the shield lead leaves the cable. Shrink this sleeving in the same manner as before.

( ) Refer to Pictorial 2-7 and push a clip insulator over the inner lead of the test cable with its large end facing the end of the cable.

( ) Refer to Detail 2-7D and install an alligator clip on the end of the inner lead.

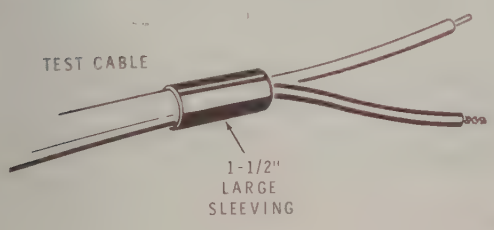
( ) Push the clip insulator over the alligator clip.

( ) In the same manner push a clip insulator over the shield lead.

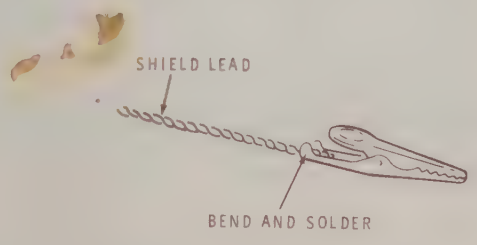
( ) Refer to Detail 2-7E and install an alligator clip on the end of the shield lead.

( ) Push the clip insulator over the alligator clip.

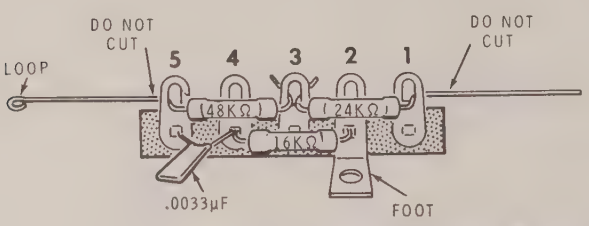
Set the test cable aside and proceed to "Notch Filter Assembly."



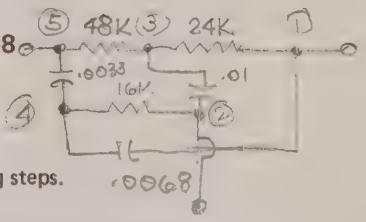
Detail 2-7C



Detail 2-7E



PICTORIAL 2-8



NOTCH FILTER ASSEMBLY

Refer to Pictorial 2-8 for the following steps.

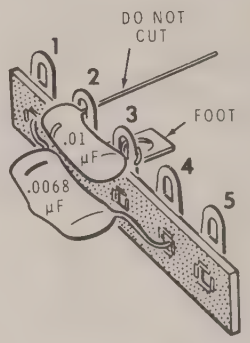
( ) Locate the 5-lug terminal strip and position it as shown with the foot toward you.

( ) C101: Connect a .0033 μF Mylar capacitor between the eyelet of lug 5 (S-1) and the eyelet of lug 4 (NS).

( ) R103: Connect a 16 kΩ (brown-blue-black-red), precision resistor between the eyelet of lug 4 (NS) and the eyelet of lug 2 (S-1).

( ) R101: Connect a 48 kΩ (yellow-gray-black-red), precision resistor between lugs 5 (S-1) and 3 (NS). Then bend a loop in the end of the indicated lead. Do not cut this lead off.

( ) R102: Connect a 24 kΩ (red-yellow-black-red), precision resistor between lugs 3 (NS) and 1 (S-1). Do not cut off the lead coming from lug 1.



PICTORIAL 2-9

Refer to Pictorial 2-9 for the following steps.

( ) Position the terminal strip so the foot is facing away from you.

( ) C102: Connect a .0068 μF Mylar capacitor between the eyelet of lug 1 (S-1) and the eyelet of lug 4 (S-3).

( ) C103: Connect a .01 μF Mylar capacitor between lugs 2 (S-1) and 3 (S-3). Do not cut off the lead coming from lug 2.

This completes the notch filter assembly. Temporarily set the notch filter aside and proceed to " Calibration."

CALIBRATION

FREQUENCY AND SYMMETRY ADJUSTMENTS

CALIBRATION

NOTE: The accuracy of the calibration of your Function Generator is dependent upon the accuracy of your oscilloscope.

There are two methods described here for calibrating your Function Generator. Method #1 requires the use of a triggered oscilloscope and a frequency counter. Method #2 requires the use of a triggered oscilloscope only. If you have the required equipment, use Method #1 to calibrate your Function Generator.

CAUTION: Dangerous AC voltage is present around the line cord leads on the circuit board and on the back of switch SW3. Keep your hands clear of these areas as you make the calibration adjustments.

METHOD #1

Equipment needed:

Triggered oscilloscope.
Frequency counter.

( ) Refer to Figure 1-1 (fold-out from Page 33) and connect the oscilloscope and the frequency counter to the Function Generator.

Set the front panel controls on the Generator as follows:

( ) ATTENUATION (dB) (SW3; black knob) to 10.
( ) FREQUENCY MULTIPLIER (SW1; black knob) to 1k.
( ) FUNCTION (SW2; red knob) to ∿.

Refer to Figure 1-2 (fold-out from Page 33) for the following steps.

Set the controls on the circuit board as follows:

( ) HIGH FREQ DIAL ADJ (R4) to the center of rotation.
( ) LOW FREQ DIAL ADJ (R2) to the center of rotation.
( ) SYM ADJ (R7) to the center of rotation.

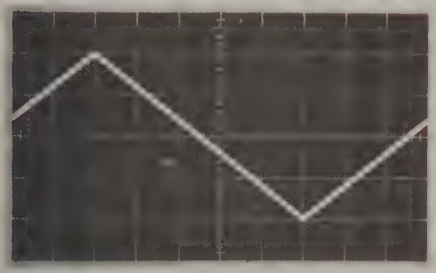
( ) Connect the line cords of the Function Generator, oscilloscope, and frequency counter to AC outlets.

( ) Turn the equipment on and let it warm up.

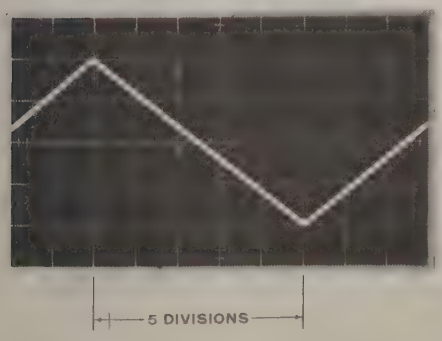
1. ( ) Set the oscilloscope TIME/CM switch to 1 mSEC/DIV.

2. ( ) Set the front panel FREQUENCY (Hz) control (R301) to 0.1.

3. ( ) Adjust the oscilloscope to obtain the following trace. NOTE: It may be necessary to adjust the LOW FREQUENCY DIAL ADJ to obtain this trace.



4. ( ) Turn the LOW FREQ DIAL ADJ control (R2) on the circuit board so that the negative going ramp covers five divisions.



5. ( ) Now turn the SYM ADJ control (R7) on the circuit board so that the positive going ramp covers five divisions.

6. ( ) Turn DC OFFSET ADJ control R32 to move the wave-shape so it is equally positioned above and below the zero reference line on the oscilloscope.

7. ( ) Set the FREQUENCY (Hz) dial (R301) on the front panel of the Generator to 10.

8. ( ) Turn the HIGH FREQ DIAL ADJ control (R4) on the circuit board until the frequency counter reads 10 kHz.

9. ( ) Set the FREQUENCY (Hz) dial (R301) on the front panel of the Generator to 1.

10. ( ) Now turn LOW FREQ DIAL ADJ control (R2) for 1000 Hz on the counter.

11. ( ) Repeat steps 1 through 10 twice more. The adjustment of the Low Frequency Dial Adj control and the Sym Adj control interact and have a direct relation to the amount of distortion out of the Generator. Therefore, do these adjustments carefully.

12. ( ) Set the Frequency (Hz) dial (R301) on the front panel of the Generator to 10.

13. ( ) Set the FREQUENCY MULTIPLIER on the front panel of the Generator to 10 k.

14. ( ) Turn the 10 k ADJ trimmer (C4) on the circuit board until the frequency counter reads 100 kHz.

15. ( ) Set the FREQUENCY MULTIPLER SW1 on the front panel of the Generator to 100 k.

16. ( ) Turn the 100 k ADJ trimmer (C3) on the circuit board until the frequency counter reads 1 MHz.

( ) Disconnect the oscilloscope and frequency counter from the Generator. These instruments will not be used any more.

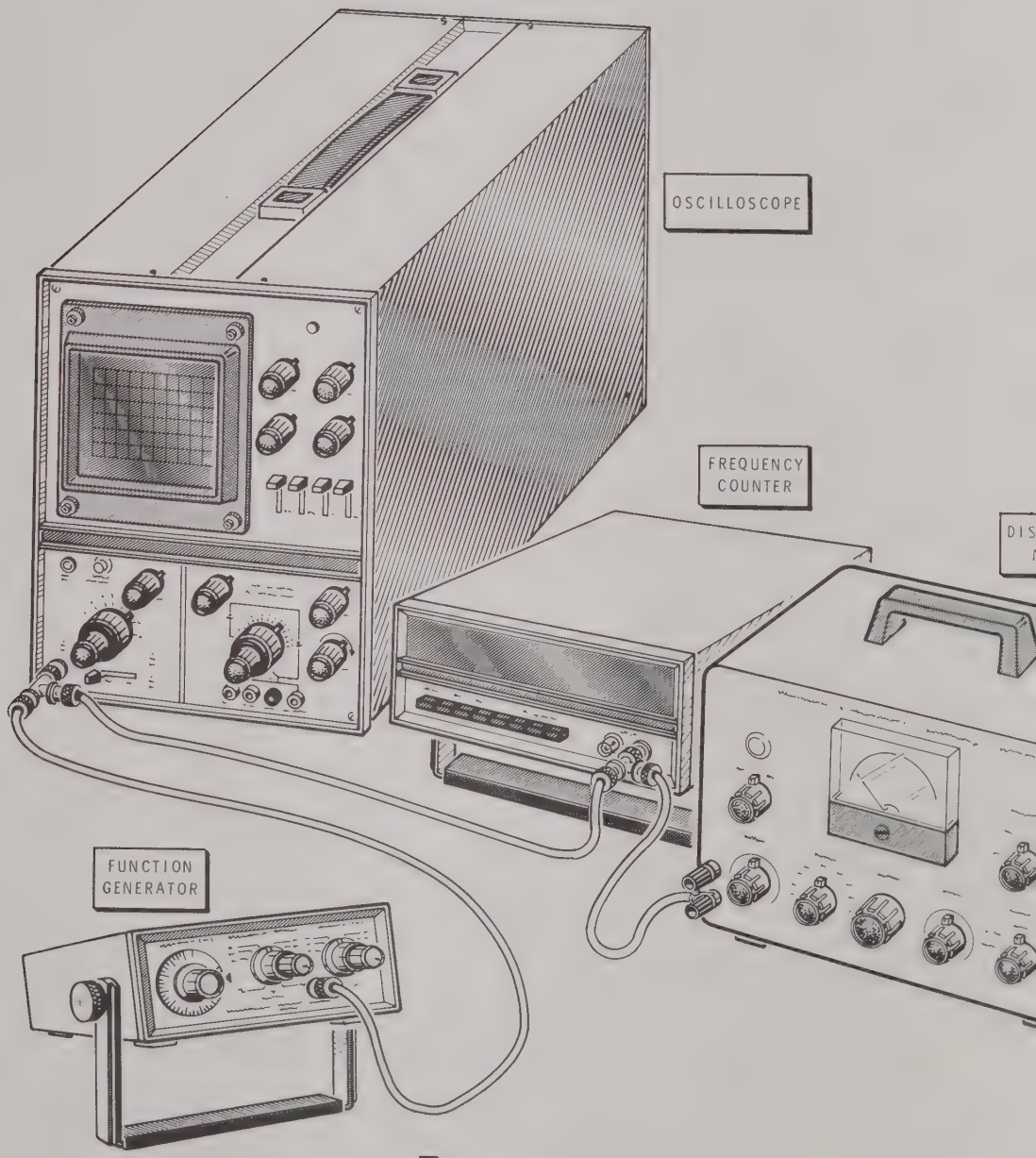


Figure 1-1

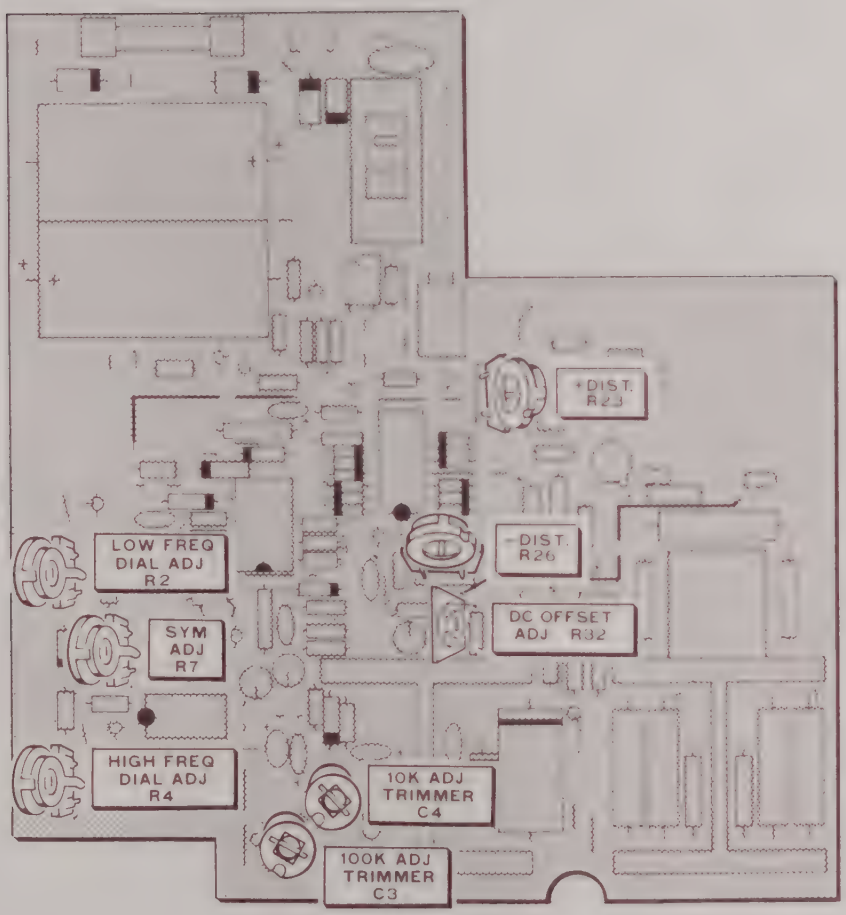
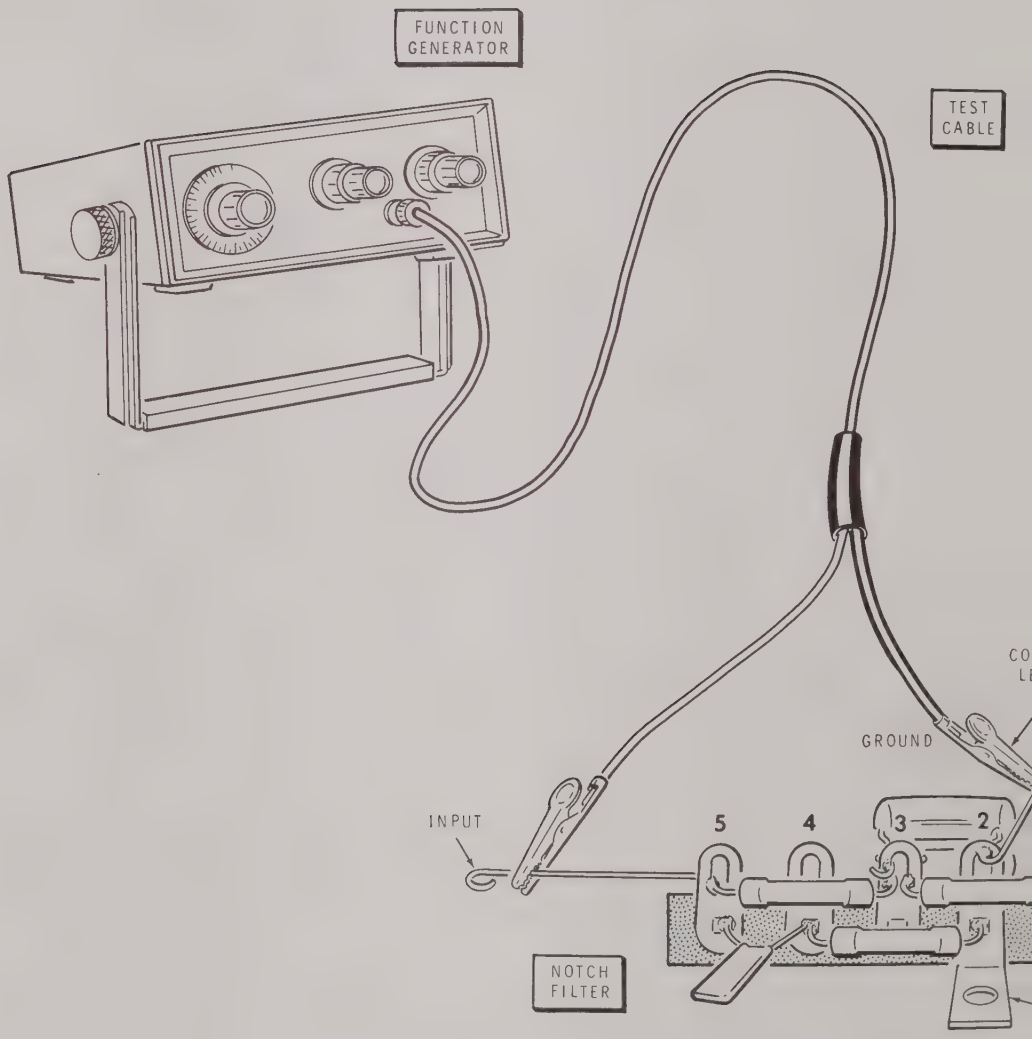
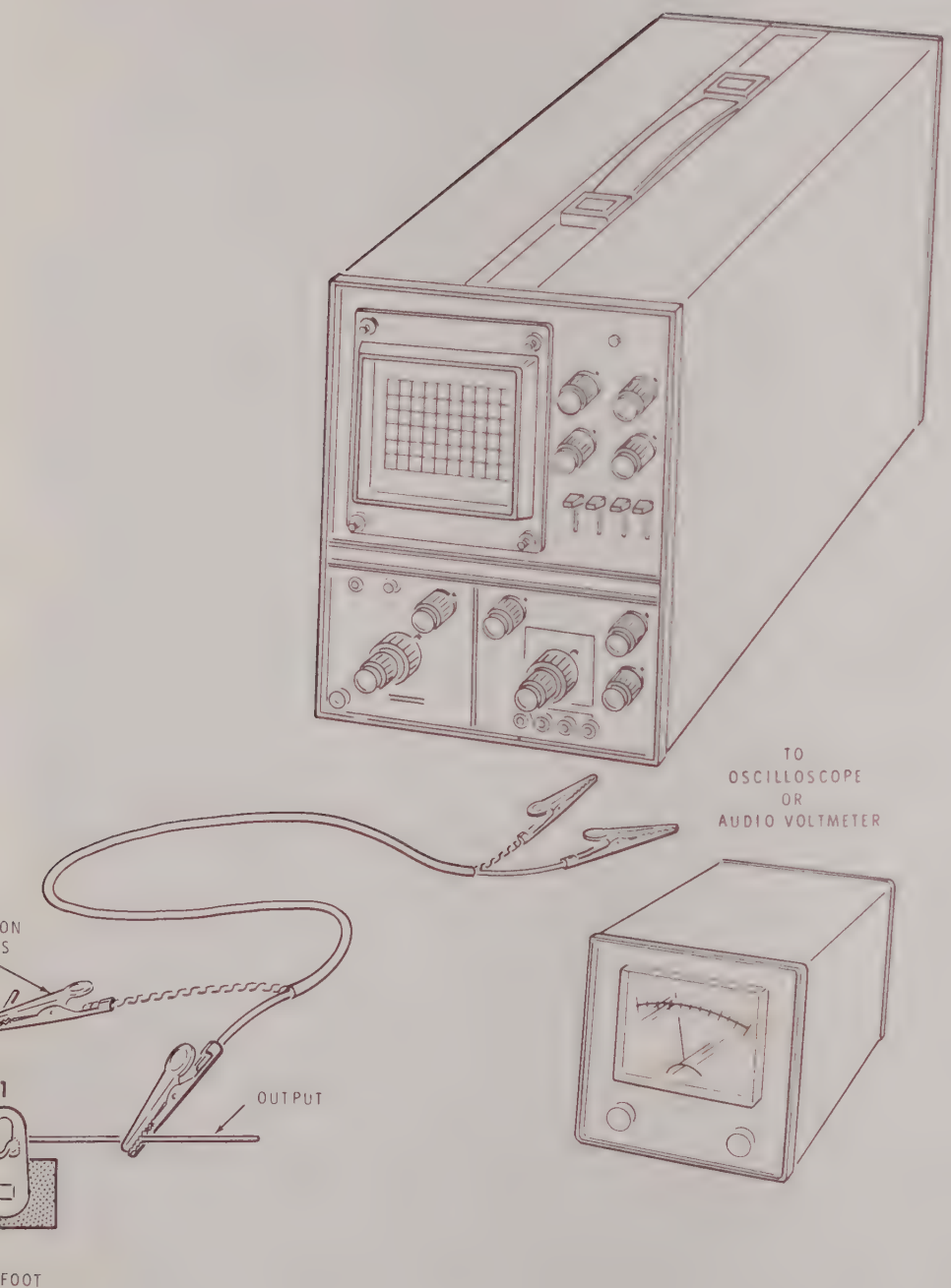

+DIST.
R23
-DIST.
R26
LOW FREQ
DIAL ADJ
R2
SYM
ADJ
R7
DC OFFSET
ADJ R32
HIGH FREQ
DIAL ADJ
R4
10K ADJ
TRIMMER
C4
100K ADJ
TRIMMER
C3

Figure 1-2


FUNCTION GENERATOR
TEST CABLE
GROUND
INPUT
5
4
3
2
NOTCH FILTER

Figu



e 1-4

METHOD #2

Equipment needed:

Triggered oscilloscope.

( ) Refer to Figure 1-3 and connect the triggered oscilloscope to the Function Generator output.

Set the front panel controls on the Generator as follows:

( ) ATTENUATION (dB) (SW3; black knob) to 10.
( ) FREQUENCY MULTIPLIER (SW1; black knob) to 1k.
( ) FUNCTION (SW2; red knob) to ∿ .

Refer to Figure 1-2 (fold-out from Page 33) for the following steps;

Set the controls on the circuit board as follows:

( ) HIGH FREQ DIAL ADJ (R4) to the center of rotation.
( ) LOW FREQ DIAL ADJ (R2) to the center of rotation.
( ) SYM ADJ (R7) to the center of rotation.

( ) Connect the line cords of the Function Generator and oscilloscope to AC outlets.

( ) Turn the Function Generator and oscilloscope power switches on.

1. ( ) Set the oscilloscope TIME/CM switch to 1 mSEC/DIV.

2. ( ) Set the front panel FREQUENCY (Hz) control (R301) to 0.1.

3. ( ) Adjust the oscilloscope to obtain the following trace. NOTE: It may be necessary to adjust the LOW FREQUENCY DIAL ADJ control (R2) of the Generator to obtain this trace.

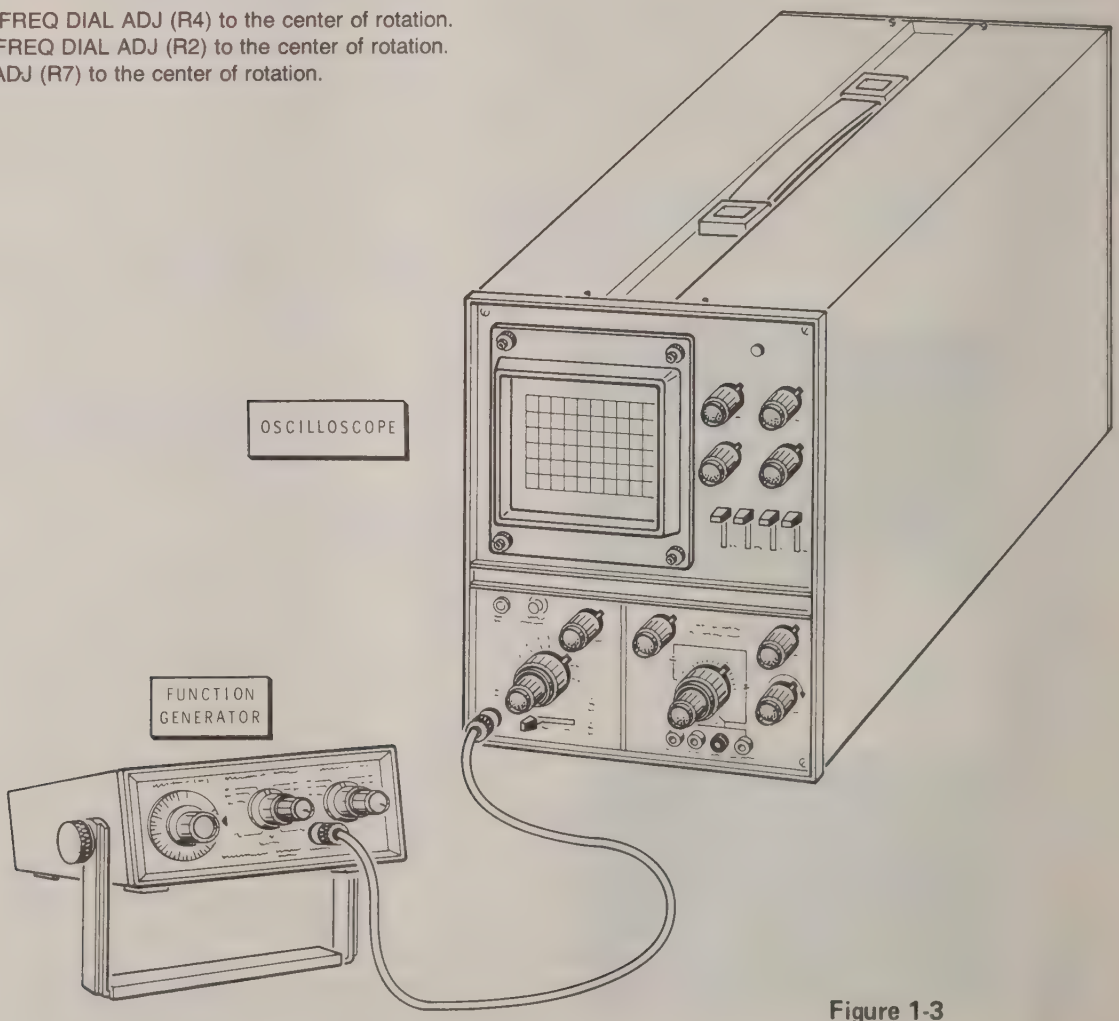
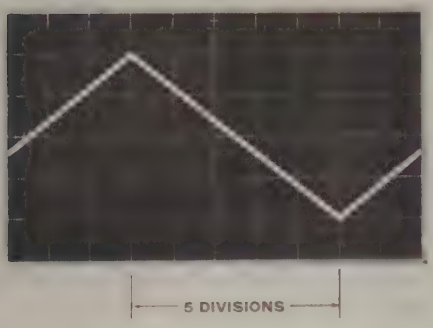
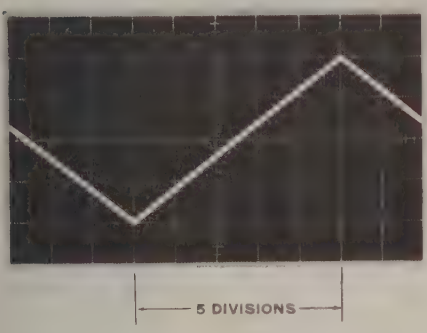


Figure 1-3

4. ( ) Turn the LOW FREQ DIAL ADJ control (R2) on the circuit board so that the negative going ramp of the waveform covers five divisions.



5. ( ) Now turn the SYM ADJ control (R7) on the circuit board so that the positive going ramp of the waveform covers five divisions.



6. ( ) Set the FREQUENCY dial (R301) on the front panel of the Generator to 10.

7. ( ) Set the oscilloscope TIME/CM switch to 10 μSEC/DIV.

8. ( ) Turn the HIGH FREQ DIAL ADJ control (R4) on the circuit board so that the positive going ramp plus the negative going ramp covers ten divisions.

9. ( ) Repeat steps 1 through 8 at least twice more to achieve a greater accuracy, since adjustment of one control affects other adjustments.

10. ( ) Make sure that the FREQUENCY (Hz) dial (R301) on the front panel of the Generator is set at 10.

11. ( ) Set the FREQUENCY MULTIPLIER (SW1) on the front panel of the Generator to 10 k.

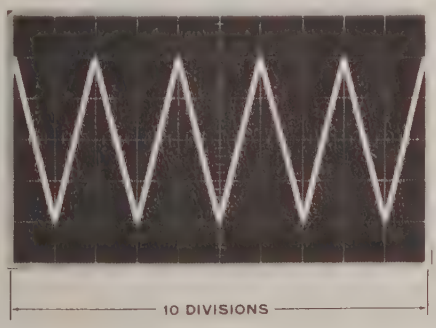
12. ( ) Set the oscilloscope TIME/CM switch to 2 μSEC/DIV.

13. ( ) Turn the 10 k ADJ trimmer (C4) on the circuit board so the positive going ramp plus the negative going ramp covers five divisions.

14. ( ) Set the FREQUENCY MULTIPLIER (SW1) on the front panel of the Generator to 100 k.

15. ( ) Set the oscilloscope TIME/CM switch to .5 μSEC/DIV.

16. ( ) Turn the 100 k ADJ trimmer (C3) on the circuit board so that five cycles cover ten divisions.



This completes "Frequency and Symmetry Adjustments." Proceed to "Distortion Adjustments."

DISTORTION ADJUSTMENTS

Equipment needed:

Oscilloscope (with a 100 mV/div sensitivity) or an audio voltmeter (with a 300 mV full-scale sensitivity).

Refer to Figure 1-4 (fold-out from Page 1-34) for the following steps.

( ) Connect the test cable to the Function Generator.

( ) Connect the inner lead at the other end of the test cable to the input lead of the notch filter. This is the lead with the loop, coming from lug 5.

( ) Connect the shield lead of the test cable to the ground lead of the notch filter. This is the lead coming from lug 2.

( ) Connect the positive lead coming from the oscilloscope or audio voltmeter to the output lead of the notch filter. This is the lead coming from lug 1.

( ) Connect the negative lead coming from the oscilloscope or audio voltmeter to the ground lead of the notch filter.

( ) Set the Function Generator controls as follows:

FREQUENCY (Hz) dial: Full counterclockwise.
FREQUENCY MULTIPLIER (black knob): 1k.
FUNCTION (red knob): ∿.
ATTENUATION (black knob): 0 dB.
VARIABLE (red knob): Full clockwise.

( ) Turn the equipment on and permit a short time for warmup.

( ) NOTE: It is suggested that you perform the following adjustments once to become familiar with the procedure. Then perform the adjustments again.

( ) Slowly turn the FREQUENCY (Hz) dial clockwise to obtain a minimum output indication on the oscilloscope or audio voltmeter.

( ) Adjust the + DIST (R23) and the – DIST (R26) controls to obtain a minimum output indication on the oscilloscope or audio voltmeter.

This completes the calibration of your Function Generator. Proceed to " Final Assembly."

FINAL ASSEMBLY

Refer to Pictorial 3-1 for the following steps.

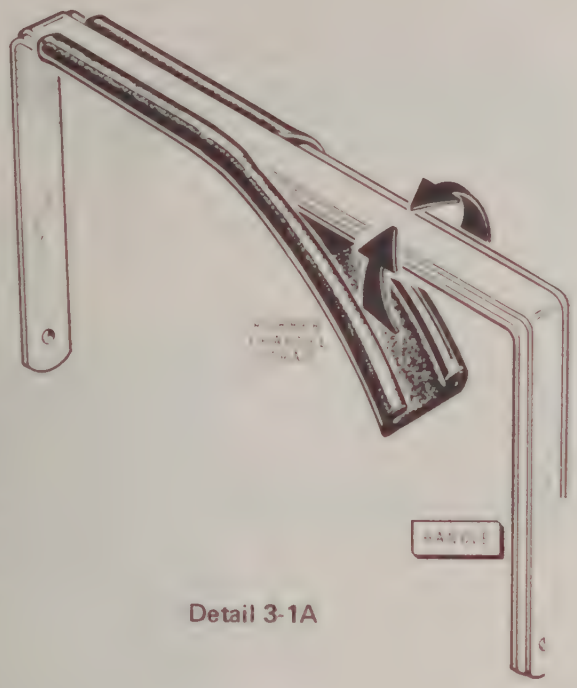
( ) Slide the cabinet onto the Generator from the back. Secure the cabinet with four 6-32 x 3/8" black screws.

( ) Locate the rubber channel strap and the handle. Fit the channel strap around the underside of the handle.

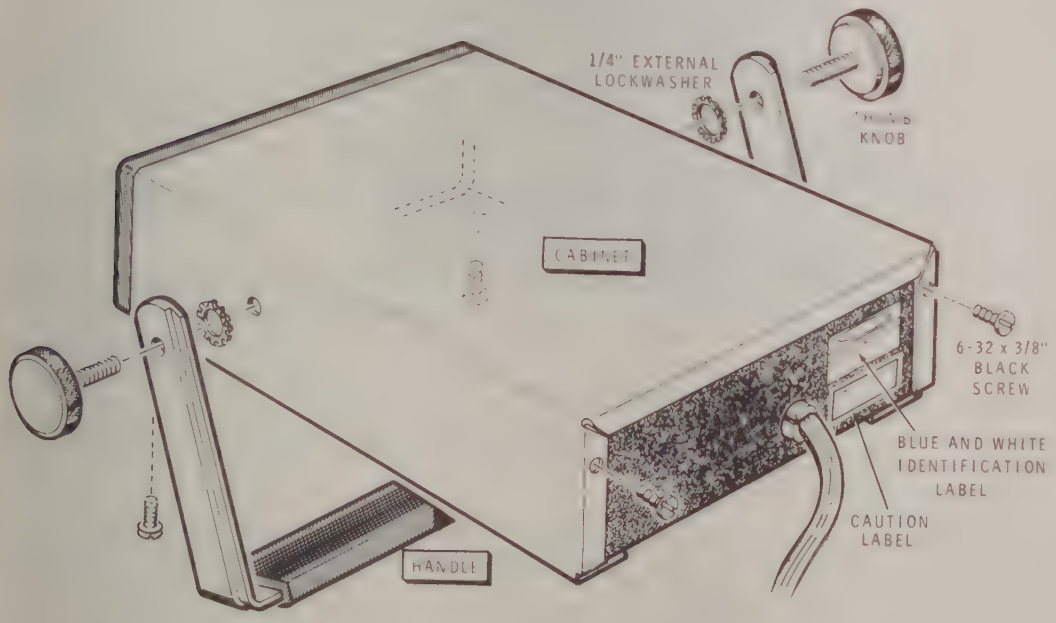
( ) Mount the handle to the cabinet with two 1/4" external lockwashers and two thumb knobs. Position the lockwasher between the handle and the cabinet.

( ) Peel the protective paper backing from the caution label. Affix this label to the back of the Function Generator near the line cord.

( ) Peel the protective paper backing from the blue and white identification label. Then press the label onto the back of the Function Generator. Refer to the numbers on this label in any communications you have with the Heath Company about this kit.



Detail 3-1A

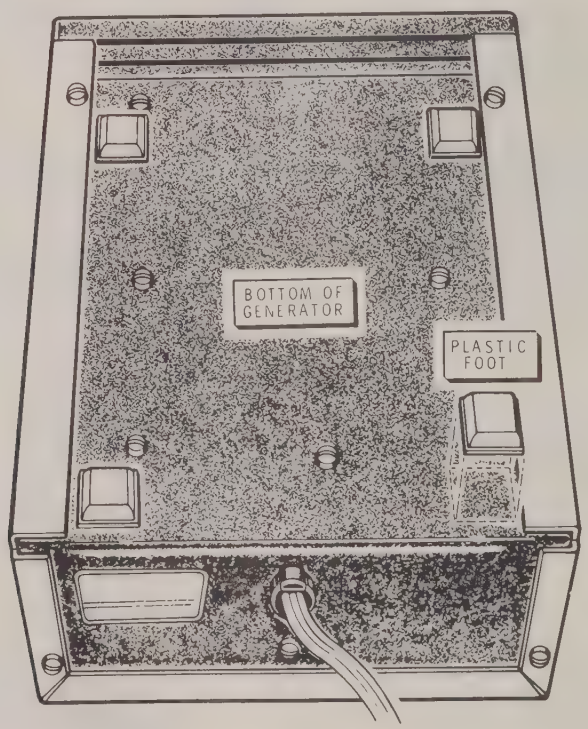


PICTORIAL 3-1

Refer to Pictorial 3-2 for the following step.

( ) Peel the protective paper backing from the plastic feet and press the feet onto the bottom of the Generator as shown. Position the back feet at least 1/2" from the rear edge of the chassis.

This completes the "Final Assembly" of your Function Generator. Proceed to "Operation."



PICTORIAL 3-2

OPERATION

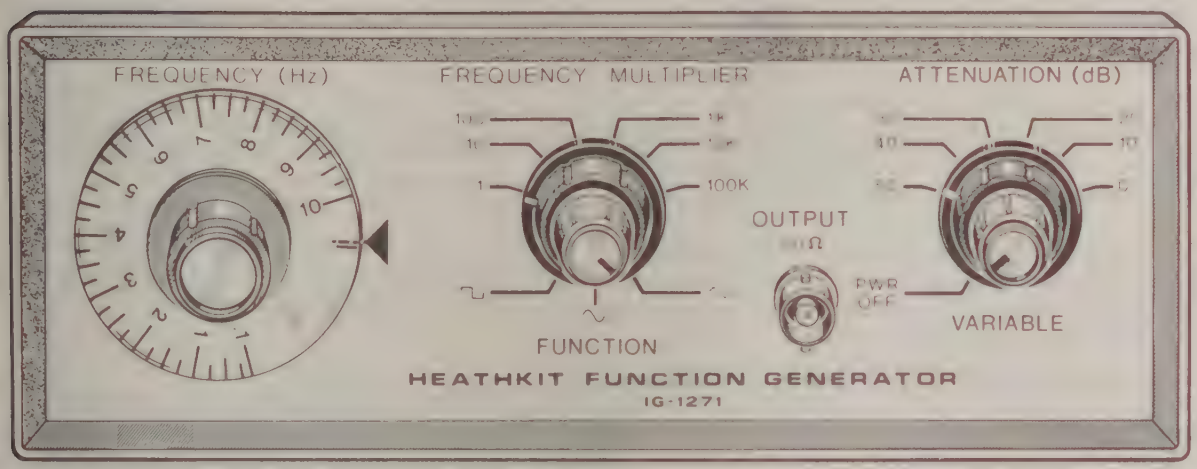


Figure 2-1

NOTE: For best results in the square wave mode, the generator output should be connected through a 50 Ω coaxial line to a 50 Ω load.

CAUTION: Never operate the Generator into less than a 50 Ω load.

Refer to Figure 2-1 for the locations of the controls and connector described below.

FREQUENCY (Hz) DIAL (R5) - Adjusts the frequency over 100 to 1 ratio.

FREQUENCY MULTIPLIER (SW1) - This multiplies the frequency range over which the frequency dial operates. Using both the frequency multiplier and the frequency dial, you can select any frequency from 0.1 Hz to 1 MHz.

FUNCTION (SW2) - This switch selects a sine wave, square wave, or triangle wave signal, and connects it to the output.

ATTENUATION (dB) (SW3) — This switch provides six steps of attenuation that add 10 dB of attenuation per step. (See the attenuation-output chart.)

VARIABLE/PWR OFF (R33-SW5) — This switch applies or removes power from the Generator circuits. Also, further rotation of this control will provide decreased attenuation of the output signal.

OUTPUT 50 Ω — This provides a signal output matched for a 50 Ω load.

ATTENUATION—OUTPUT CHART

This chart shows comparative generator output voltage divisions with each setting of the attenuation control. Each division is made using zero attenuation output as a reference (variable attenuation set for 10V P-P output). For example: If your generator output with zero attenuation is 10 volts peak-to-peak, this same output will be 1 volt peak-to-peak with 20 dB attenuation. 10V P-P÷10=1 volt P-P (third line on chart).

ATTENUATION (dB)	DIVIDE ZERO ATTENUATION OUTPUT BY:	OUT VOLTAGES INTO A 50 Ω LOAD
0 dB	1.0	10V P-P
10 dB	3.16	3.16V P-P
20 dB	10	1V P-P
30 dB	31.6	.316V P-P
40 dB	100	.1v P-P
50 dB	316	.0316V P-P

IN CASE OF DIFFICULTY

This section of the Manual is divided into two parts. The first part is a list of "General Checks." These are the most commonly made errors.

The second section, the "Troubleshooting Chart," contains symptoms and their possible causes. Along with the possible causes you will be instructed to make voltage measurements and check for waveforms with an oscilloscope.

Refer to the schematic diagram (fold-out from Page 49) and the circuit board voltages on Page 48 for the correct voltage readings. Also read the "Circuit Description" for a better understanding of the circuits.

CAUTION: The full AC line voltage is present inside the chassis as shown on Page 47. Be careful to avoid electrical shock when you work on the unit.

If you are unable to resolve your problem with the "General Check" or the "Troubleshooting Chart," refer to "Customer Service" inside the rear cover of the Manual.

GENERAL CHECKS

1. About 90% of the kits that are returned for repair do not work properly because of poor solder connections. Therefore, many difficulties can be eliminated by careful inspection of connections to make sure they are soldered as described in the "Soldering" section of the "Kit Builders Guide." Reheat any connections that look doubtful and be sure all the wires are soldered at places where more than one wire is connected to the same lug.

2. Check the circuit board to be sure that there are no solder bridges between adjacent foils. Remove any solder bridges that may exist.

3. Make sure that each transistor and integrated circuit is in its proper location. Make sure that each transistor lead is in its correct hole and properly soldered.

4. Check capacitor values carefully. Be sure that the proper part is installed at each location. Check each electrolytic capacitor to be sure that the plus (+) marked lead is properly positioned.

5. Check the resistors carefully. It would be easy to install a 220 Ω (red-red-brown) resistor in place of a 22 kΩ (red-red-orange) for example.

6. Be sure of correct diode locations and installation. For instance, the stabistor diode (#56-61) may be the same size, shape, and color as the 1N4149 diode (#56-65). Yet these diodes will not operate if they are interchanged. Also, the 1N751 diode (#56-16), which may be marked with (violet-green-brown) color bands, could be mistakenly installed for a 1N750A diode (#56-59), which may be marked with (violet-green-black-brown) color bands.

7. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you have overlooked.

8. Check the wires and cables around the front panel controls. Make sure none of these wires are pinched by the cabinet. Also check for pinched wires under the spacers that mount the circuit board to the chassis.

9. Check for excess lead lengths on the foil side of the circuit board that may touch each other or the chassis when the board is mounted.

Troubleshooting Chart

An oscilloscope and a high impedance voltmeter will be required for this section. Refer to the "Schematic" Diagram (fold-out from Page 49) for voltages and waveforms. Refer to the "Circuit Board Voltages" on Page 48 for voltages.

SYMPTOM	POSSIBLE CAUSE
Fuse blows.	1. Power transformer incorrectly wired. 2. Diodes D15, D16, D17, D18, may be incorrectly installed or shorted. 3. IC2 or transistor Q25 may be incorrectly installed or shorted. 4. Transistor Q22 or Q24 incorrectly installed or shorted.
No output.	1. Check power supply voltages. 2. If power supply voltages are correct, check for triangle waveform at Gate of transistor Q17. 3. If waveform is present at Q17, trouble is in power amplifier. Check voltages. 4. If waveform is not present at Q17, check voltages on transistors Q4, Q5, Q6, Q7, and Q8.
Triangle and square waves are obtainable, but no sine wave.	1. Resistor R22, diodes D2 and D8, and transistors Q13 and Q14.
Sine wave is distorted on the negative half cycle.	1. Transistors Q14 and Q16, and diodes D8 through D13.
Sine wave is distorted on the positive half cycle.	1. Transistors Q13 and Q15, and diodes D2 through D7.
Triangle wave is obtainable but no square wave.	1. Transistor Q12, diode ZD4, capacitor C16, and resistor R19.
DC is offset at the output on the triangle and sine waves only.	1. Transistors Q17 and Q18. 2. Capacitors C12, C13, and C17. 3. Resistors R13, R14, R16, R17, R31, and R32.
DC is offset at the output on the square wave only.	1. Transistor Q12. 2. Diode ZD4. 3. Capacitor C16 and resistors R19 and R21.

CIRCUIT DESCRIPTION

The Function Generator first generates a triangle waveform of the selected frequency. Then the triangle wave is shaped to produce a sine wave or used to trigger other circuitry to produce a square wave. Refer to the Schematic Diagram (fold-out from Page 49) while you read this description.

TRIANGLE WAVEFORM

The triangle waveform is generated by transistors Q7, Q8, Q9, Q10, Q11; multiplier capacitor C3, C4, C5, C6, C7, C8, or C9; and IC1.

Transistor Q7 conducts only on the positive going ramp of each waveform. Transistor Q8, however, conducts all the time. The current that is supplied by transistor Q7 is divided exactly in half by transistor Q8. Half of this current is directed through Q8 and the remaining half is coupled to the multiplier capacitor to charge it. This is shown in Figure 3-1.

The multiplier capacitor charges to +5 volts, which is coupled through transistor Q9 to the voltage divider network made up of resistors R9, R11, and R12. This voltage divider supplies +1 volt of the +5 volts from the multiplier capacitor to pins 2 and 12 of IC1. Therefore, if we were to view this at point A in Figure 3-1 we would see a symmetrical voltage rise (positive ramp) from -5 volts to +5 volts.

IC1 is a dual comparator IC. During the positive going ramp, the voltages at pins 4 and 8 are approximately +5 volts and transistor Q11 is not conducting. As the multiplier capacitor charges, and the voltage at pins 2 and 12 approaches +1 volt, IC1 switches and the voltage at pins 4 and 8 becomes low (+.4 volt). This causes transistor Q11 to conduct, which cuts off transistor Q7.

At this time, transistor Q8, which is always conducting, will begin to charge the multiplier capacitor from +5 volts to -5 volts. This causes a linear voltage change in the negative direction (negative going ramp). It is important to note at this time that the current required to charge the multiplier capacitor to -5 volts is exactly equal to the current that charged it to +5 volts. Thus a symmetrical triangle wave is produced. See Figure 3-2.

During the negative going ramp, the voltage at pins 4 and 8 of IC1 is approximately .4 volt. As the multiplier capacitor charges to −5 volts, the voltage divider network supplies −1 volt of the −5 volts to pins 2 and 12 of IC1. When the voltage at pins 2 and 12 of IC1 approaches −1 volt, IC1 switches again and the voltage at pins 4 and 8 becomes high (approximately +5 volts). This allows transistor Q7 to conduct again and another positive going ramp starts.

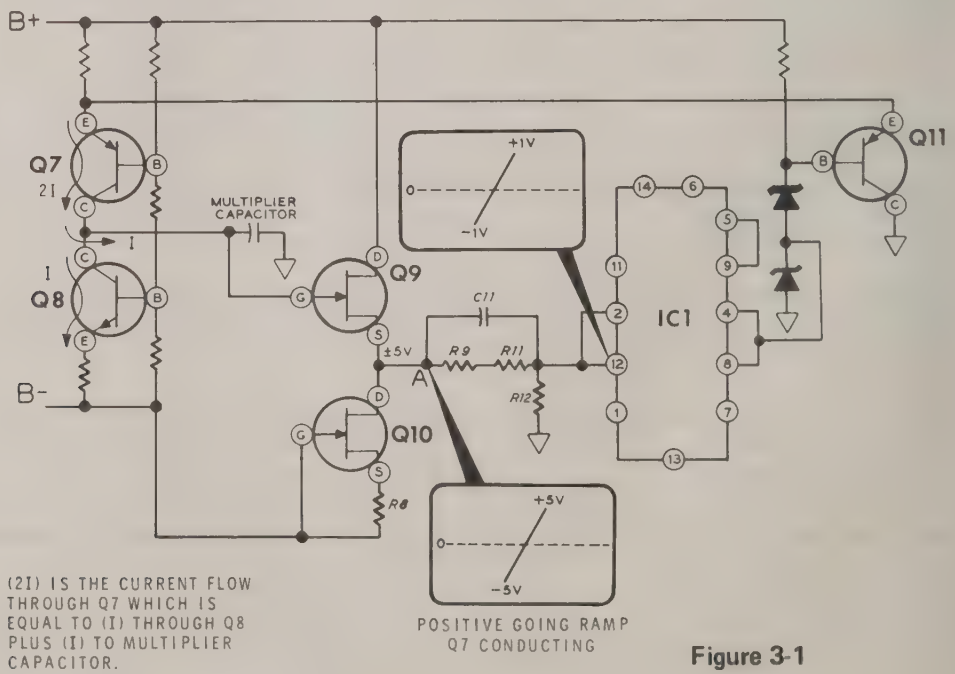


Figure 3-1

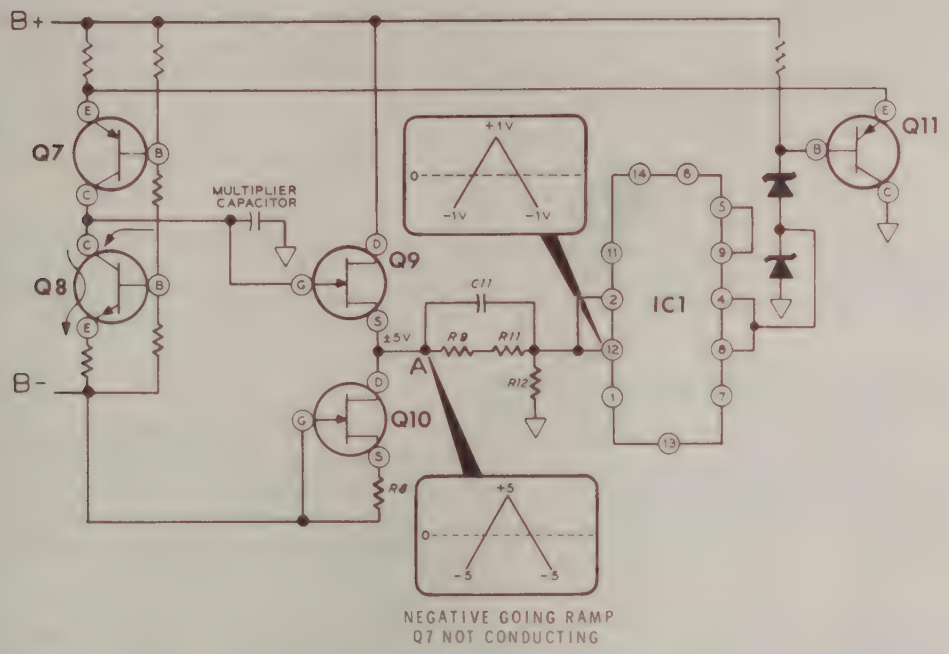


Figure 3-2

The Symmetry adjust control, R7, balances the circuit so the current supplied by transistor Q7 is exactly twice the current coupled through transistor Q8. This control compensates for the unbalance in the circuit that is caused by resistor tolerances and variations in transistor leakage currents.

FREQUENCY CONTROL

For a given frequency, the time that is required for the multiplier capacitor to charge and discharge remains constant because the current flow through transistors Q7 and Q8 remains constant. However, as Frequency control R301 is turned counterclockwise and selects a more negative voltage, the voltage on the base of transistor Q4 becomes more negative. This causes the voltage on the collector of Q4, and also the base of Q5, to become more positive. At the same time, the voltage on the emitter of Q4 and the base of Q6 becomes more negative. This reduces the amount of current that is flowing in these transistors. Since the emitters of these transistors are connected to the emitters of Q7 and Q8, the amount of current that flows in Q5 and Q6 must be drawn away from the emitters of Q7 and Q8. Therefore, as the current flow in transistors Q5 and Q6 decreases, the current flow in transistors Q7 and Q8 increases.

Note that resistor R103 is one half of the value of R108. This is to insure that as the current flow in transistors Q7 and Q8 changes with frequency, the current flow change in transistor Q7 will always be exactly twice the current change in transistor Q8.

As the current flow in transistors Q7 and Q8 increases, the multiplier capacitor will charge more quickly and the output frequency is increased.

Transistors Q1 and Q2 provide a constant negative voltage to one end of R301. Transistor Q3 provides a constant negative voltage to the other end of R301. Controls R2 and R4 provide biasing for these transistors.

SQUARE WAVE GENERATION

Each time IC1 switches, the voltage at pins 4 and 8 of IC1 goes from .4 volt to 5 volts, or from 5 volts to .4 volt. This sudden voltage change is a square wave of the same frequency as the triangle wave. The square wave is coupled to transistor Q12 which amplifies the signal and level-translates the signal so its negative and positive excursions are of equal amplitude from the zero reference.

SINE WAVE SHAPING

A sine wave is generated by feeding a triangle wave through resistor R22 to a nonlinear voltage controlled resistance network. That is, as the triangle wave increases in amplitude (negative or positive), the resistance in the network decreases. Conversely, as the amplitude of the triangle wave decreases, the resistance of the network increases. This results in a triangle wave that is rounded off on each extreme, and rounding off more and more as the amplitude increases. This shapes the triangle wave into a sine wave.

The positive side of this voltage-controlled resistance network is made up of transistors Q13 and Q15; resistors R207, R208, R209, R210, R211, R212; and diodes D2, D3, D4, D5, D6, and D7. The negative side of the network is made up of transistors Q14 and Q16; resistors R201, R202, R203, R204, R205, and R206; and diodes D8, D9, D10, D11, D12, and D13.

Since the negative side of the shaper works the same as the positive side, except in a negative direction, only the positive side will be discussed.

Transistor Q13 and Q15 sets the positive bias levels to the resistance network. Resistors R207, R208, R209, R210, R211, and R212 form a voltage divider. This voltage divider reverse biases diodes D7, D6, D5, D4, D3, and D2 with different amounts of reverse bias on each diode.

As the positive half of the triangle waveform begins to rise in amplitude, the reverse bias on diode D7 is overcome and the diode begins to conduct. This changes the total resistance of the network and the triangle wave shape is changed slightly. As the amplitude of the triangle wave continues to increase, each diode in turn begins to conduct and reduces the total resistance of the network.

As the amplitude decreases, each diode now stops conducting as its reverse bias point is reached and the trailing edge of the positive half of the sine wave is formed.

OUTPUT AMPLIFIER

Transistor Q17 reduces the loading on the sine wave shaper and the triangle generator circuit. Transistor Q18 provides temperature compensation for Q17 and capacitor C17 eliminates high frequency switching transients from the waveforms.

Transistors Q19 and Q20 form a differential amplifier. This amplifier drives voltage amplifier Q21. From transistor Q21 the generator signal is coupled to transistor Q22 and through diode D14 to transistor Q24. This complementary emitter follower circuit provides the low output impedance necessary for driving a 50-ohm load.

Resistors R39 and R38 provide negative feedback from the output to the base of transistor Q20. This further reduces the output impedance and increases the input impedance to a point where the loading on Variable Attenuator R33 is insignificant.

Transistor Q23 acts as a constant current source in order to improve both the common mode rejection and power supply rejection of the amplifier. Resistor R47 in conjunction with the output impedance of the amplifier provides the 50-ohm impedance necessary to properly match the 50-ohm load.

The output attenuator is made up of three 50-ohm resistance networks. Switch SW3 connects these networks in varying combinations to provide discrete 10 dB steps from 0 dB to 50 dB.

POWER SUPPLY

Transformer T1 has two primary windings which are connected through switch SW4 to provide operation on either 120 VAC or 240 VAC supplies. The reduced AC voltage is rectified by diodes D15, D16, D17, and D18 and filtered by capacitors C24 and C25. This produces a negative and a positive 25 volt supply which is used to power the output amplifier and voltage regulator circuits.

Integrated circuit IC2 is a voltage regulator which supplies +15V to the generator circuits. The -15 volts for the generator circuits is derived from the -25 volts by a discrete voltage regulator. Transistor Q25 is the series pass element with the -15 volts taken from its emitter.

Transistors Q27 and Q28 form a difference amplifier which compares the difference between the +15 volts and ground, and the -15 volts and ground. Any detected difference is amplified by transistor Q26 and coupled back to transistor Q25. Thus the -15 volt supply will stay exactly equal in potential but opposite in polarity to the +15 volt supply.

Resistors R18, R15, and zener diodes ZD1, ZD5, supply the positive and negative 5 volts needed to operate IC1.

SPECIFICATIONS

Frequency Range	1.0 Hz to 1 MHz.
Functions	
Triangle Waveform	Nonlinearity, 5% maximum. Symmetry within 10% of 50% duty cycle.
Square Waveform	100 ns maximum rise or fall time. Symmetry within 10% of 50% duty cycle.
Sine Waveform	Harmonic distortion; 3% maximum, 5 Hz to 100 kHz.
Attenuator	0 to 50 dB in 10 dB steps. 0 to 20 dB minimum variable. ±1 dB accuracy.
Output	10 volts peak-to-peak into 50 ohms, 20 volts peak-to-peak into open circuit. 50 ohms impedance ±5%. ±1.5 dB flatness from .1 Hz to 1 MHz.
Power Requirements	105-130 volts or 210-260 volts RMS, 50-60 Hz. 15 watts maximum.
Operating Temperature	0 to 40°C ambient.
Dimensions	8-7/8" deep, 7-1/4" wide, 3" high (with handle removed).
Net Weight	4.2 lbs.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

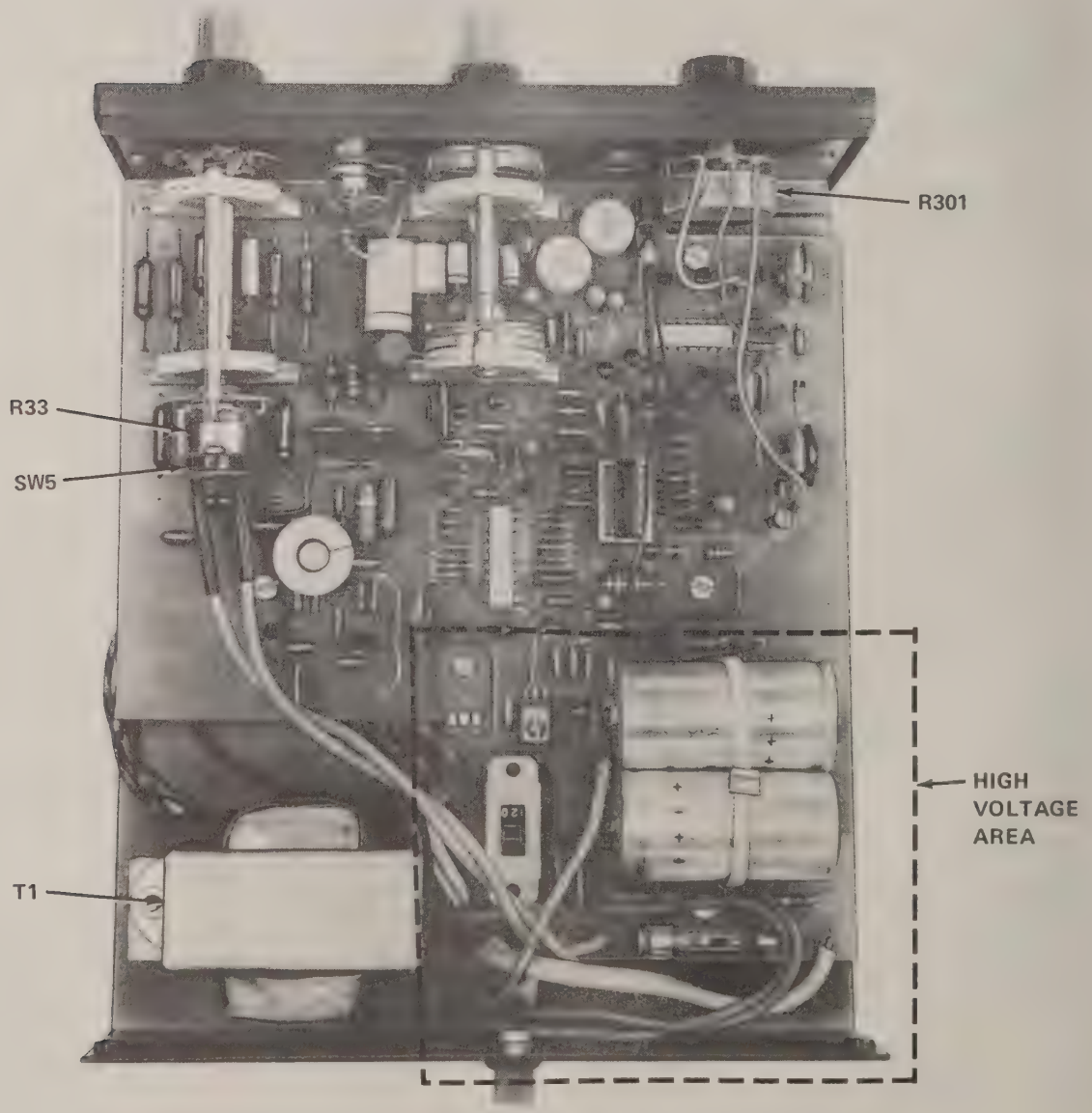
CHASSIS PHOTOGRAPH

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

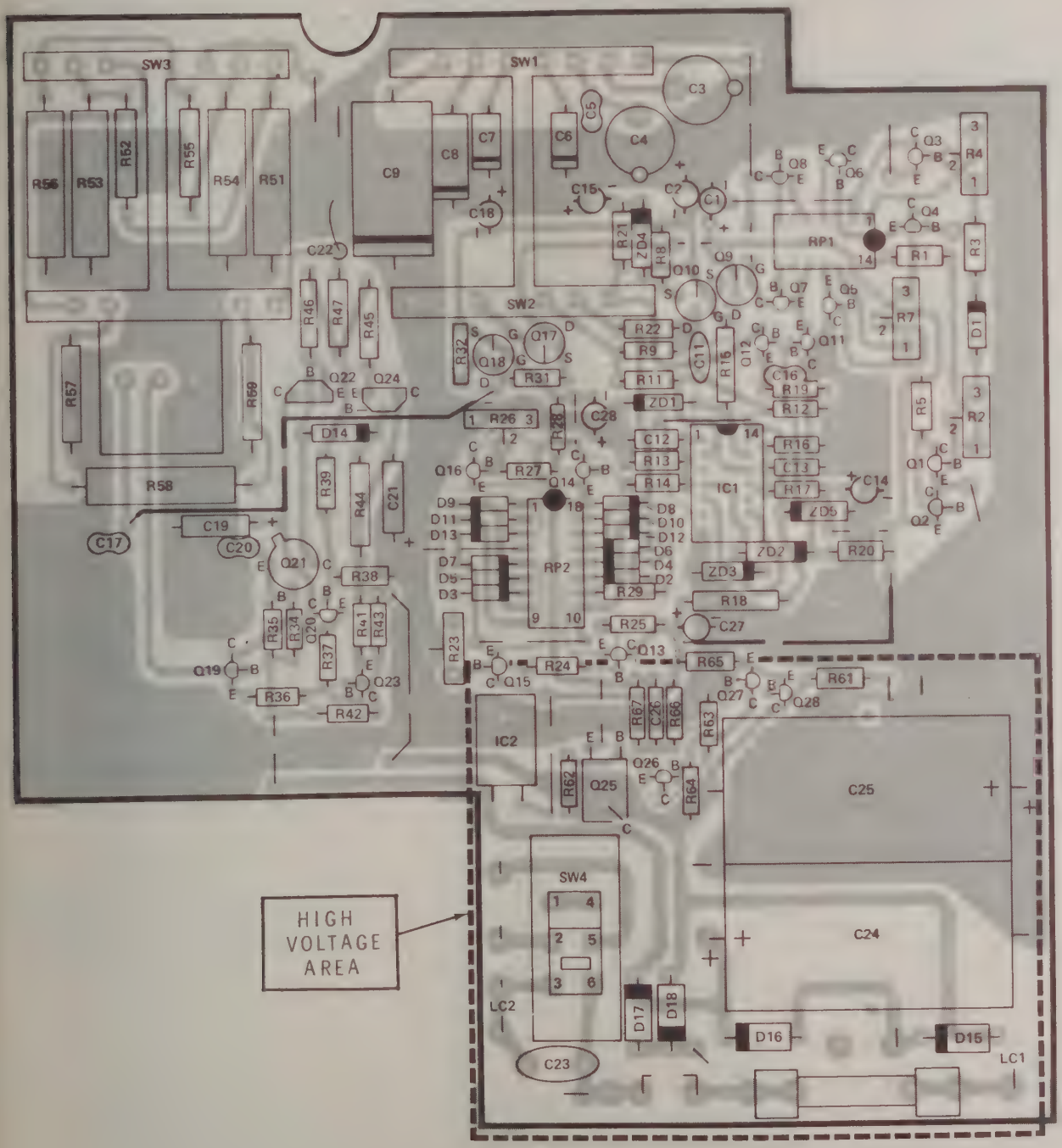
A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View" or "Chassis Photograph."

B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.

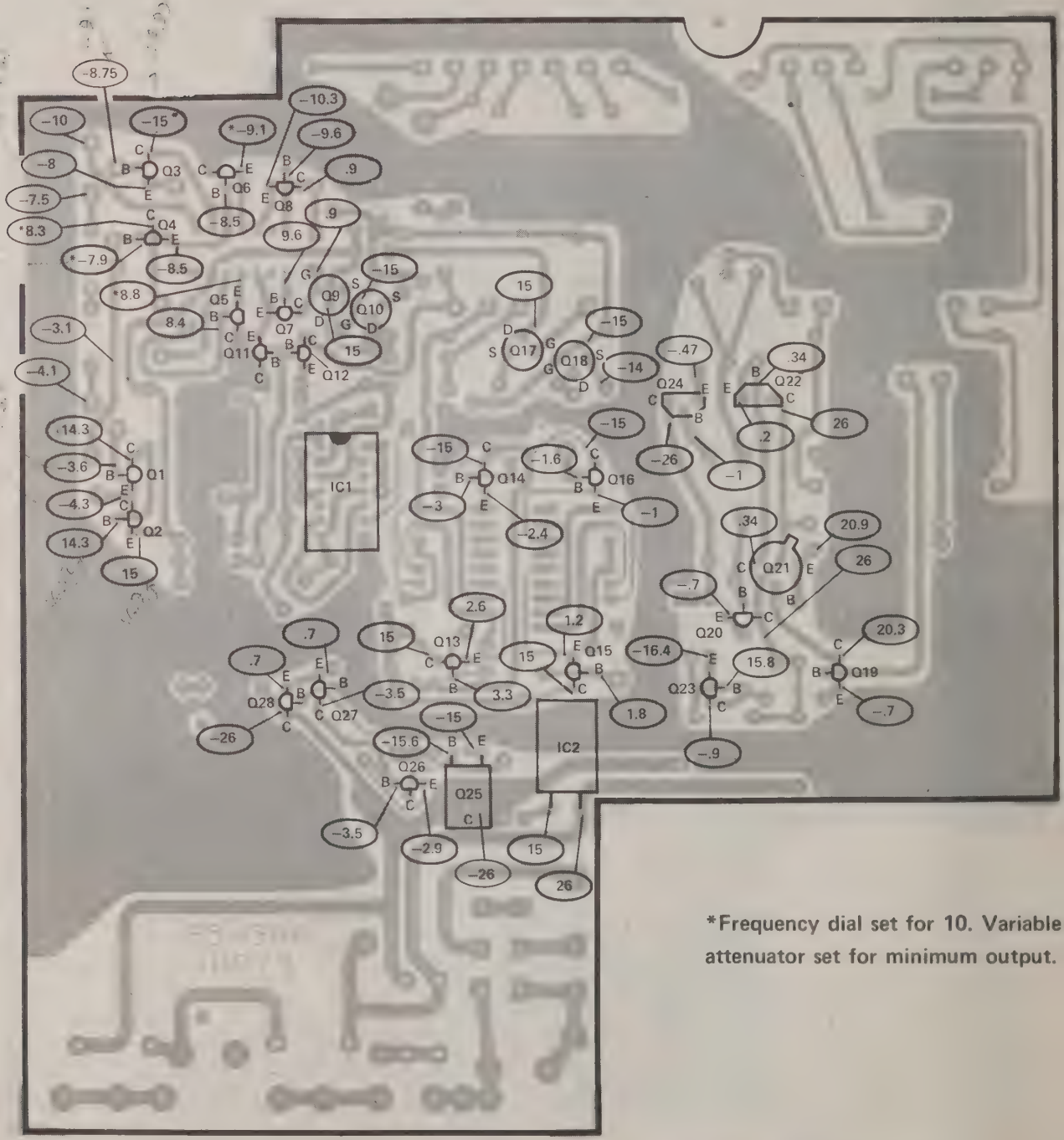
C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



CIRCUIT BOARD X-RAY VIEW



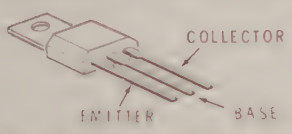
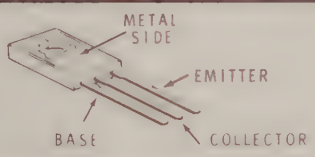
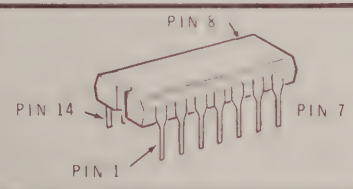
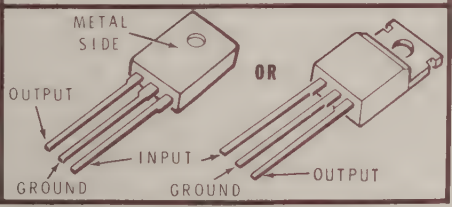
CIRCUIT BOARD VOLTAGE CHART

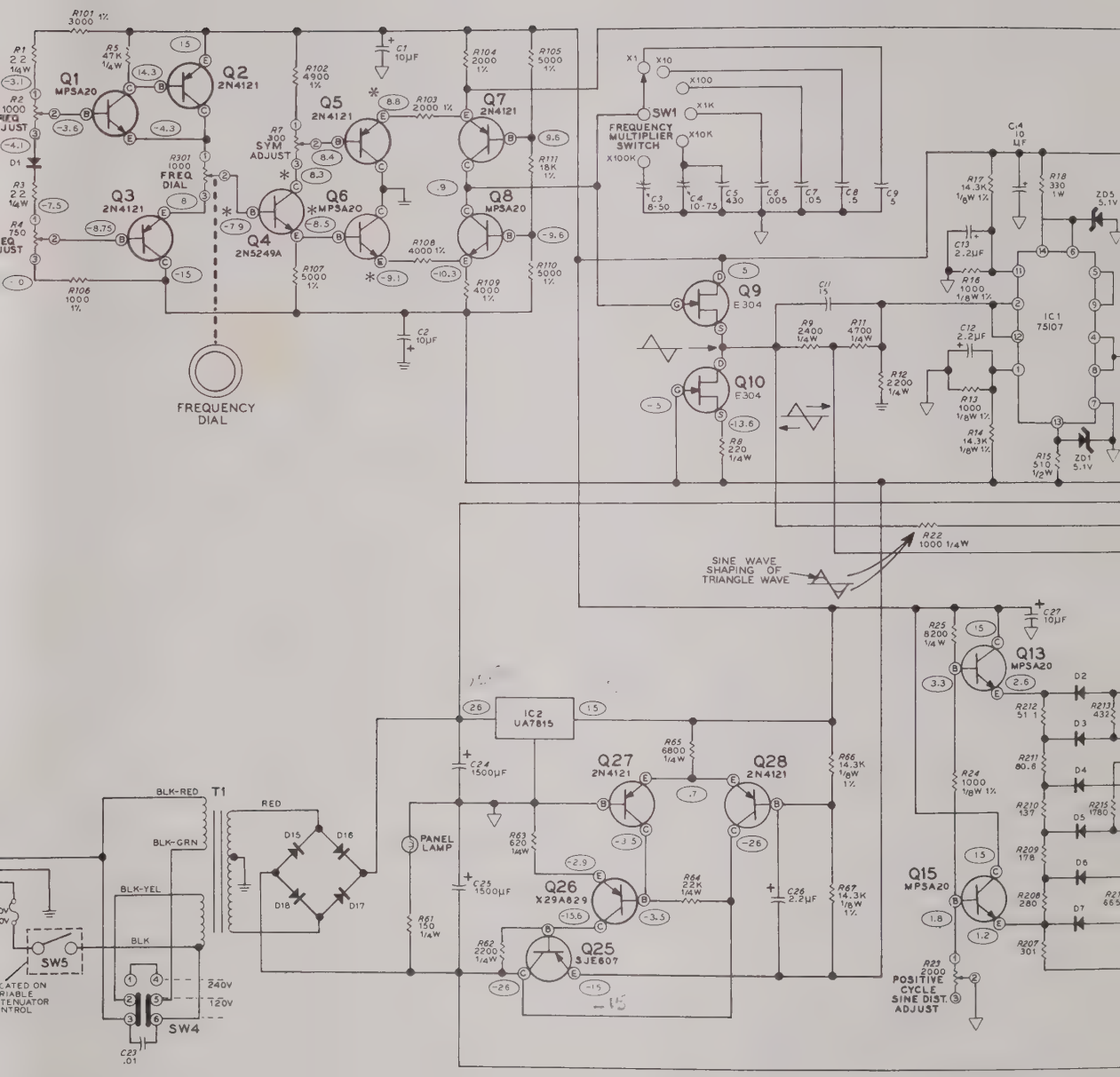


*Frequency dial set for 10. Variable attenuator set for minimum output.

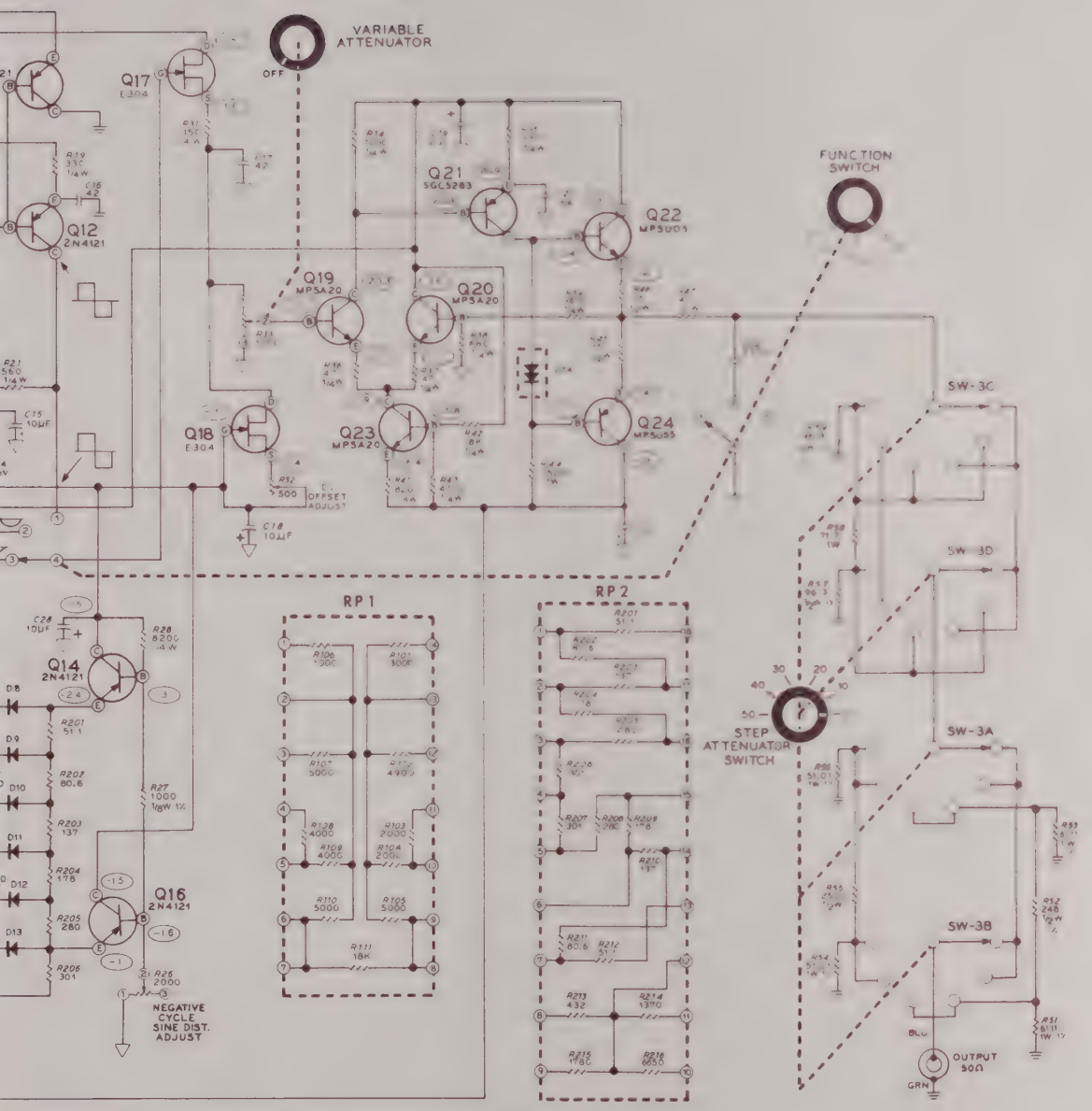
(SHOWN FROM FOIL SIDE)

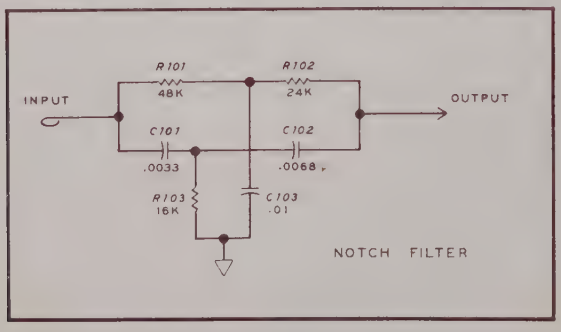
IDENTIFICATION CHART

SCHEMATIC REFERENCE NUMBER	HEATH PART NUMBER	MANUFACTURER'S NUMBER	BASE DIAGRAM
Q1, Q6, Q8, Q13, Q15, Q19, Q20, Q23.	417-801	MPSA20	
Q2, Q3, Q5, Q7, Q11, Q12, Q14, Q16, Q27, Q28.	417-235	2N4121	
Q4	417-213	2N5249A	
Q26	417-201	X29A829	
Q9, Q10, Q17, Q18.	417-828	E304 (SELECTED)	
Q21	417-270	SGC5283	
Q22	417-224	MPSU05	
Q24	417-225	MPSU55	
Q25	417-263	SJE607	
IC-1	442-73	75107	
IC-2	442-63	UA7815	



SCHEMATIC OF T
HEATHKIT®
MODEL IG-1271
FUNCTION GENERA


VARIABLE ATTENUATOR
OFF
Q17
E304
Q12
2N4121
Q21
SGC5283
Q22
MPSU05
Q19
MPSA20
Q20
MPSA20
Q18
E304
Q23
MPSA20
Q24
MPSU55
OFFSET ADJUST
FUNCTION SWITCH
SW-3C
SW-3D
SW-3A
SW-3B
STEP ATTENUATOR SWITCH
RP 1
RP 2
Q14
2N4121
Q16
2N4121
NEGATIVE CYCLE SINE DIST. ADJUST
OUTPUT 50Ω
BLU
GRN


INPUT
R101
48K
R102
24K
OUTPUT
C101
.0033
C102
.0068
R103
16K
C103
.01
NOTCH FILTER

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

DO NOT WRITE IN THIS SPACE

INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, $3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

  Total enclosed $_____
- If you prefer COD shipment, check the COD box and mail this form. COD ☐

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____

Date Purchased _____ Location Purchased _____

LIST **HEATH** PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE
TOTAL FOR PARTS			
HANDLING AND SHIPPING			
MICHIGAN RESIDENTS ADD 4% TAX			
TOTAL AMOUNT OF ORDER			

SEND TO: **HEATH COMPANY**
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only): 616 982-3571

THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUT ALONG DOTTED LINE

FOR PARTS REQUESTS ONLY

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- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

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CITY _____

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TOTAL FOR PARTS			
HANDLING AND SHIPPING			
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BENTON HARBOR
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Phone (Replacement parts only): 616 982-3571

THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH ZENITH

MP MASTER
MA22927

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.